Post-Construction Bird and Bat Fatality Monitoring Study
Final Report
Clear Creek Energy Center
Nodaway County, Missouri

April 15, 2020 – April 14, 2021

Prepared for:

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WEST

EXECUTIVE SUMMARY

Tenaska Clear Creek Wind, LLC, contracted Western EcoSystems Technology, Inc., (WEST) to conduct a post-construction fatality monitoring study at the Clear Creek Energy Center (Project) in Nodaway County, Missouri. The Project is a 111-turbine wind energy facility that has a generating capacity of 242 megawatts (MW). The Project has been operating since early 2020.

The primary objective of this study was to estimate impacts to birds and bats resulting from operation of the Project. The study aimed to determine bird and bat fatality rates as described in the Project's Bird and Bat Conservation Strategy (BBCS) and Eagle Conservation Plan (ECP), along with guidance described in the US Fish and Wildlife Service's (USFWS) *Land-Based Wind Energy Guidelines* (USFWS 2012) and *Eagle Conservation Plan Guidance* (USFWS 2013).

This study was conducted from April 15, 2020 – April 14, 2021. Road and pad searches for all birds and bats were conducted at all turbines weekly from April 15 – October 31, 2020 and monthly from November 1, 2020 – April 14, 2021. Circular plot searches for eagles were conducted at all turbines once per month from April 15, 2020 – April 14, 2021 (unless the average vegetation height in the search plot was greater than 12 inches [30 centimeters]). Searcher efficiency and carcass persistence trials were conducted in all seasons to account for potential sources of bias. Search areas were delineated to account for unsearchable areas.

Over the study period, 3,867 road and pad searches were conducted and a total of 838 circular plot searches were conducted. During these searches, 223 bat carcasses and 50 bird carcasses were found. An additional 16 bat carcasses and nine bird carcasses were found incidentally, outside of the standardized searches. None of the carcasses found were of threatened or endangered species; but six Species of Conservation Concern were found, including bald eagle, marsh wren, hoary bat, silver-haired bat, and tri-colored bat.

Fatality rates were estimated using the GenEst estimator (a generalized estimator of fatality; for all birds, large birds, small birds, and bats) and Evidence of Absence (for bald eagles). The all bird fatality rate was 1.75 birds (90% confidence interval [CI]: 1.13–2.58) per MW, which is low compared to other facilities in the Midwest with publicly available and comparable data. Estimated fatality rates for large birds were 0.55 (90% CI: 0.26–0.93) and for small birds were 1.17 (90% CI: 0.67–1.90). The estimated bat fatality rate was 44.72 bats (90% CI: 32.28–63.29) per MW, which is higher than most other facilities in the Midwest with publicly available and comparable data.

The probability of detecting an eagle carcass (i.e. *g*-value) was 0.25 (90% CI: 0.24–0.27), based on searcher efficiency, raptor carcass persistence, search area, and seasonal patterns in eagle abundance recorded at the Project. The estimated median number of bald eagle fatalities was 4 over the study period. The estimated mean fatality rate was 5.99 bald eagles per year (90% CI: 0.7–15.62). The estimated bald eagle fatality rate during the study was less than the predicted fatality rate of 10 bald eagles per year, which had been determined using the 80th quantile of the USFWS's Collision Risk Model.

STUDY PARTICIPANTS

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REPORT REFERENCE

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ACRONYM AND ABBREVIATION LIST

Acronym	Definition
AICc	corrected Akaike Information Criteria
BBCS	Bird and Bat Conservation Strategy
carcass searches	standardized carcass searches
CI	confidence intervals
cm	centimeter
CPT	carcass persistence trial
ECP	Eagle Conservation Plan
ft	foot
in	inch
GenEst	generalized estimator of fatality
ID	identification
in	inch
k	detection reduction factor
m	meter
min	minute
MW	megawatt
PCM	post-construction fatality monitoring
Project	Clear Creek Energy Center
QA/QC	quality assurance/quality control
Tenaska	Tenaska Clear Creek Wind, LLC
US	United States
USFWS	US Fish and Wildlife Service
WEST	Western EcoSystems Technology, Inc.

INTRODUCTION

Tenaska Clear Creek Wind, LLC (Tenaska), is operating the Clear Creek Energy Center (Project) in Nodaway County, Missouri (Figure 1). The Project is a 242-megawatt (MW) wind energy facility that became operational in early 2020. The Project consists of 100 Vestas V12 2.2-MW wind turbine generators, 11 Vestas V110 2.0-MW wind turbine generators, and associated infrastructure (e.g., turbine pads, access roads, and an underground electric collection system). Turbines are primarily located in cultivated crops or hay/pasture land cover (Figure 2).

Tenaska contracted Western EcoSystems Technology, Inc. (WEST), to conduct a 1-year post-construction fatality monitoring (PCM) study. The primary objective of this study was to estimate impacts to birds and bats resulting from operation of the Project. The study aimed to determine bird and bat fatality rates as described in the Project's *Bird and Bat Conservation Strategy* (BBCS; Stantec Consulting Services 2018) and *Eagle Conservation Plan* (ECP; Tenaska 2019), along with guidance described in the US Fish and Wildlife Service's (USFWS) *Land-Based Wind Energy Guidelines* (USFWS 2012) and *Eagle Conservation Plan Guidance* (USFWS 2013). This report describes the methods and results from the 1-year PCM study conducted from April 15, 2020, to April 14, 2021.

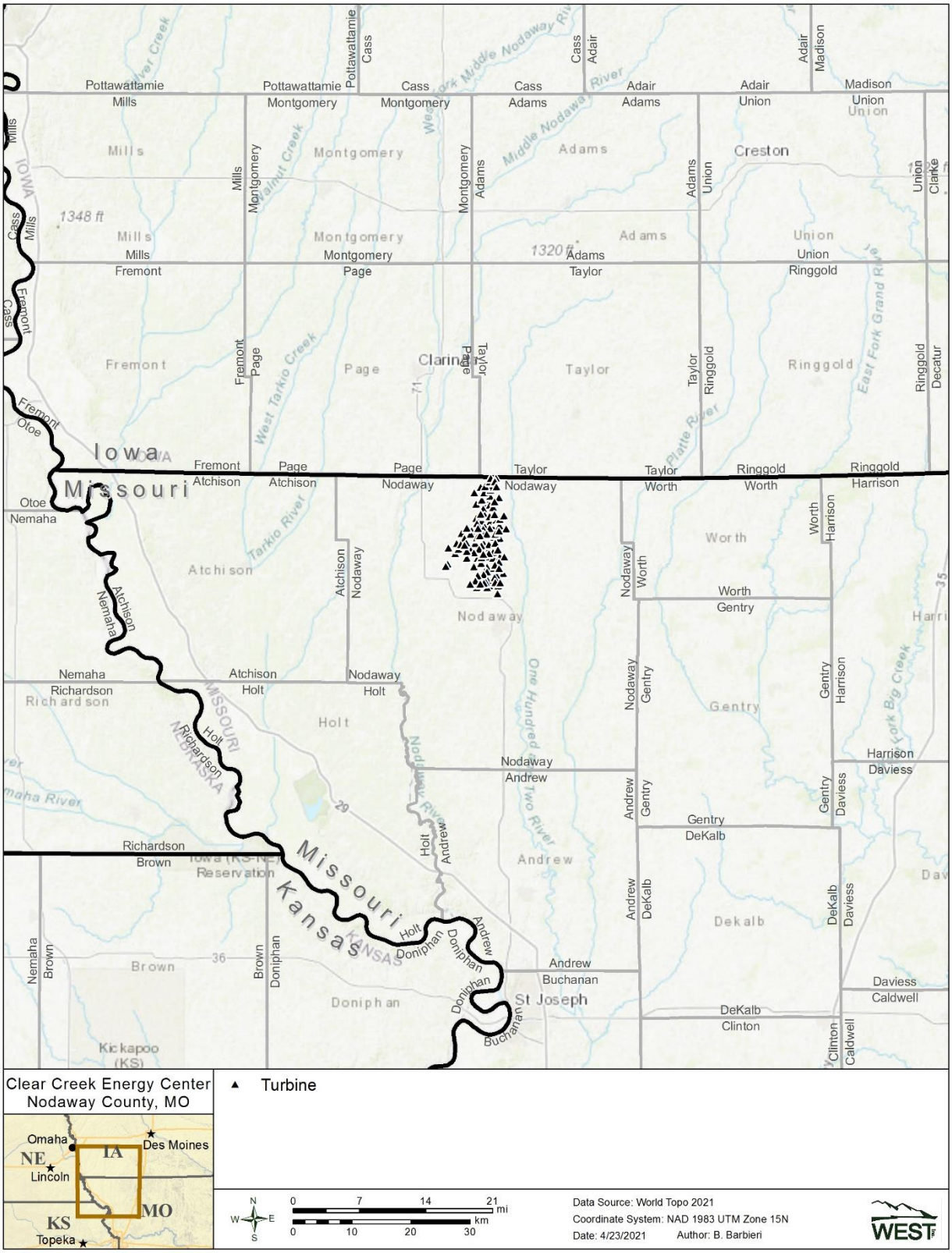

Figure 1. Location of the Clear Creek Energy Center in Nodaway County, Missouri.

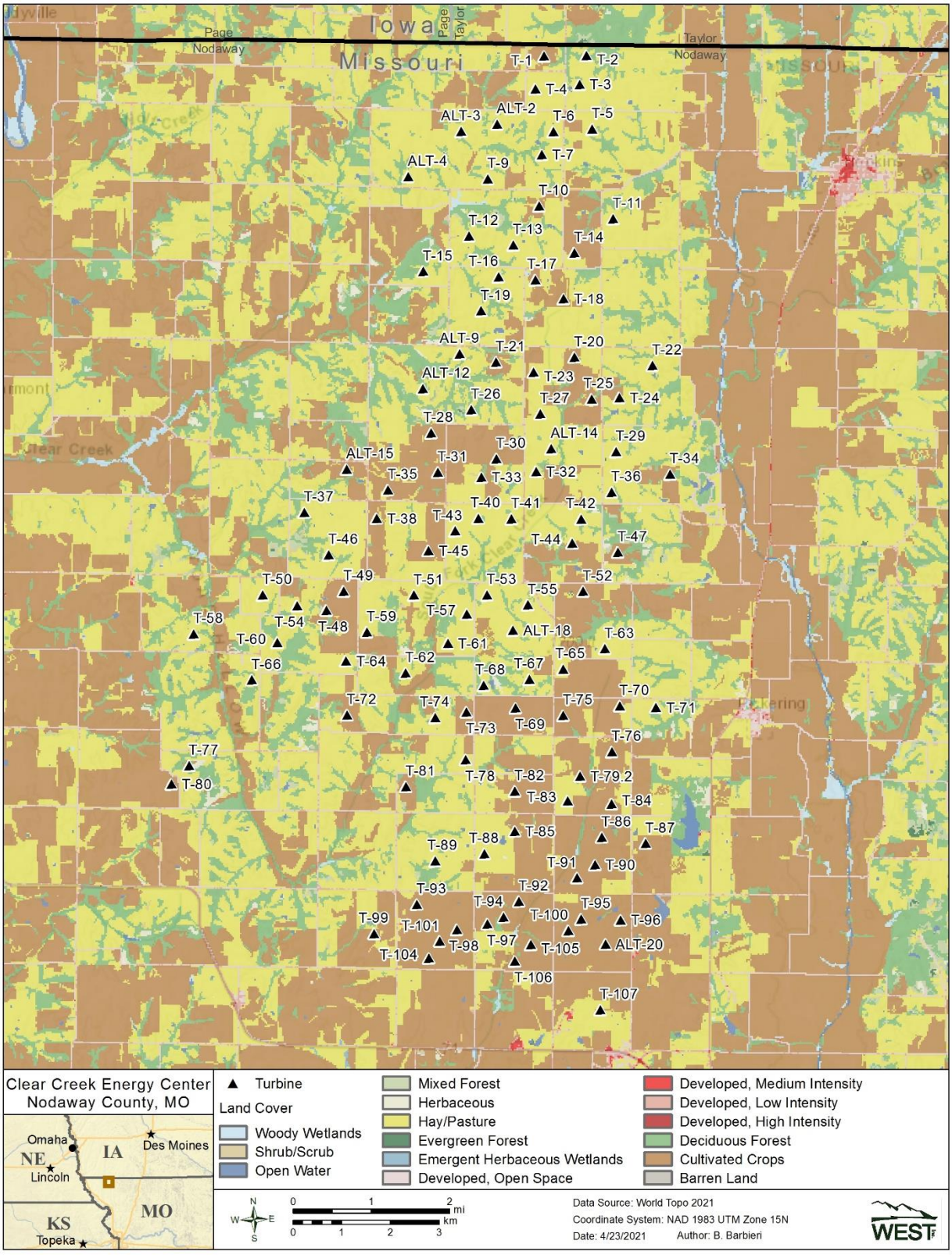

Figure 2. Land cover composition at the Clear Creek Energy Center in Nodaway County, Missouri.

METHODS

This PCM study consisted of three primary survey components: 1) standardized carcass searches (carcass searches) of turbines, 2) searcher efficiency (SEEF) trials, and 3) carcass persistence trials (CPT). Carcass searches included road and pad searches as part of the BBCS fatality monitoring and circular plot searches as part of the ECP fatality monitoring. Road and pad searches and circular plot searches were conducted at all Project turbines (Figure 3). All carcass searches were conducted by trained biological technicians (searchers). SEEF trials and CPTs were conducted in all seasons. Season dates were defined as spring (March 1 – May 13), summer (May 14 – August 28), fall (August 29 – November 30), and winter (December 1 – February 28). In addition, the search areas were delineated to account for carcasses expected to fall outside of the search plots. Each of these components are described in more detail in the sections below.

Standardized Carcass Searches

Road and Pad Searches

Road and pad searches were conducted weekly from April 15 to October 31, 2020, and monthly from November 1, 2020, to April 14, 2021. Searchers systematically walked and scanned the road and pad search area within 80 meters (m; 262 feet [ft]) of each turbine (Figure 4). Searchers began at a marked point 80 m from each turbine, walked down one side of the access road, circled around the turbine pad, and then walked back on the other side of the access road. Searchers looked for carcasses while walking at a pace of approximately 45–60 m (148–197 ft) per minute (min). For each search, the searcher recorded the date, start time, end time, searcher's initials, and turbine number. Additional data was recorded for bird and bat carcasses found during standardized searches or incidentally within the Project area (including carcasses found incidentally by Tenaska's operations staff/contractors). All bird and bat carcasses found in the search plots during standardized searches were included in the analysis, assuming the fatalities were caused by turbine collision. Any injured birds and bats found in the search plots during standardized searches were recorded and treated like fatalities in the analysis.

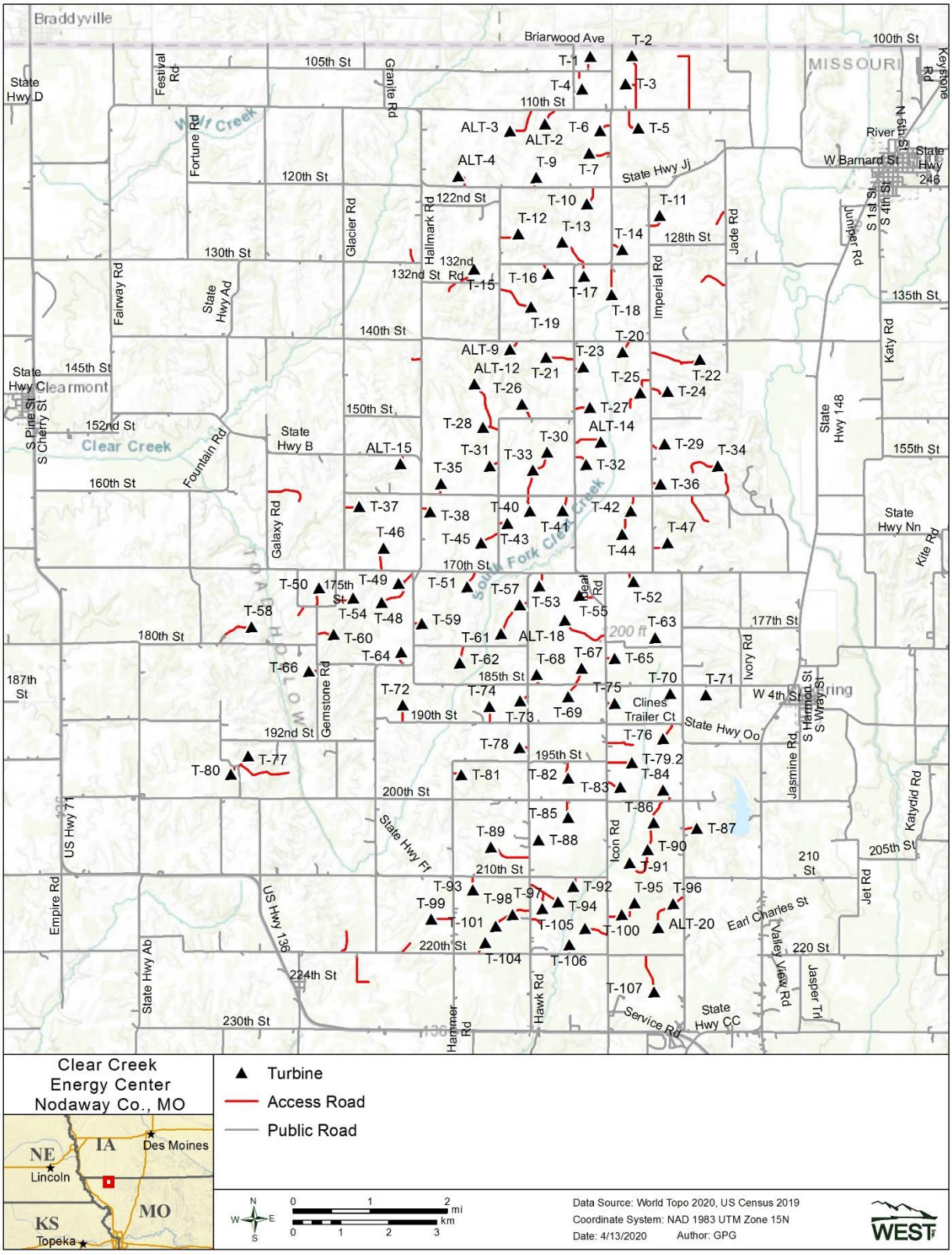

Figure 3. Location of turbines and access roads at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Figure 4. Example road and pad search area within the 80-meter (262-foot) radius of a turbine at the Clear Creek Energy Center in Nodaway County, Missouri, April 15 2020 – April 14, 2021.

When a carcass was found, the searcher placed a flag near the carcass and continued the search. After searching the entire plot, the searcher returned to any found carcasses and recorded information on a Casualty Information Form, including the following:

- Species;
- Sex (if possible);
- Age (if possible);
- Estimated time since death;
- Carcass condition;
    - Intact − a carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a scavenger;
    - Scavenged – an entire carcass that shows signs of scavenging or is heavily infested by insects, or portion(s) of a carcass in one location (e.g., wings, skeletal, legs, pieces of skin);
    - Dismembered – a partial carcass that has not been scavenged;
    - Feather Spot – 10 or more body feathers (or two or more primary feathers) at one location;
    - Injured – a live bird or bat that has apparent injuries;
- Type of injury (if possible);
- Carcass location (distance and direction from turbine and Universal Transverse Mercator coordinates).

Photographs were taken of all carcasses, including: 1) a photograph of the carcass as found, 2) a photograph showing the carcass's location relative to the turbine, and 3) a photograph(s) clearly showing distinctive features to help identify the species. All bird and bat carcasses were placed in a sealed plastic bag, labeled with a unique carcass identification number, turbine number, date, Tenaska's USFWS Special Purpose - Utility Permit number (# MB67368D-0), and stored in an assigned freezer at the Project's Operations and Maintenance Building. When handling carcasses, searchers wore nitrile and leather gloves to avoid possible transmission of diseases. All bird and or bat carcasses found in the Project area were handled and recorded following the above protocol. Any injured birds or bats were handled in accordance with permit conditions.

Biologists experienced in identifying bird and bat species verified all carcass identifications. A permitted bat biologist (Kristina Hammond [USFWS permit TE03495B-2] or Brenna Hyzy [USFWS permit TE26854C-1]) verified all bat carcasses in relatively poor condition or potentially of a sensitive species.

Circular Plot Searches

Eagle-focused circular plot searches were conducted at all turbines once per month from April 15, 2020, to April 14, 2021. During the circular plot searches, searchers walked two circular transects around the base of the turbine, with one transect located 30 m (98 ft) from the turbine

and one transect located 90 m (295 ft) from the turbine. Searchers walked the transects at a rate of approximately 45–60 m per minute, while scanning out 30 m on either side of transects for eagle carcasses. The scanned area covered a 120-m plot area around each turbine (Figure 5). When average vegetation heights within the 120-m plot exceeded 12 inches (in; 30 centimeters [cm]), searchers limited the carcass searches to visible areas within 120 m of the turbine. Information was recorded for each search as described above for road and pad searches. Carcasses found in the search plots were assumed to have been caused by turbine collision. Non-eagle carcasses found during circular plot searches were processed as described above for carcasses found during road and pad searches. Eagle carcasses found were immediately reported to the USFWS and processed as directed by the USFWS's Office of Law Enforcement and Division of Migratory Birds.

Searcher Efficiency Trials

SEEF trials were conducted to determine the probability that searchers detected bird and bat carcasses. These probabilities were used to adjust carcass counts for detection bias. SEEF trials were conducted in all search areas throughout the study period. Road and pad SEEF trials were stratified by the type and size of carcasses (large bird, small bird, or bat)[1] and season.

Bird species used for the SEEF trials included rock pigeons for large birds and 2-week old coturnix quail (*Coturnix* spp.) for small birds, both of which are commercially available and are non-native/non-protected species. SEEF trials for eagles were conducted using feathered turkey decoys. Dark-colored house mice (*Mus musculus*) were used as surrogates for bats.

Searchers were unaware of when and where SEEF carcasses would be placed. SEEF carcasses were placed in search areas at random locations before that day's scheduled search. Prior to placement, each SEEF carcass was marked with a discrete zip tie and sticker identification (ID) so it could be identified as a SEEF carcass. SEEF carcasses were dropped from waist height or higher and allowed them to land in a random posture. To avoid attracting scavengers, no more than two SEEF carcasses were placed at one time at a single turbine. Searchers recorded all SEEF carcasses found during the carcass search. Following the search, the availability of SEEF carcasses during the search was confirmed to account for carcasses removed by scavengers or other means before the search began.

[1] WEST classifies bird sizes for PCM studies by body length and, if necessary, wingspan. Large birds are defined as birds greater than 12 inches (in; 30 centimeters [cm]) in length, or between 9 in (23 cm) and 12 in, with a wingspan of more than 18 in (46 cm). Small birds are defined as birds less than or equal to 9 in in length, or between 9 and 12 in, with a wingspan of less than or equal to 18 in.

Figure 5. Example circular plot search area located within the 120-meter (394-foot) radius of a turbine at the Clear Creek Energy Center in Nodaway County, Missouri, April 15, 2020 – April 14, 2021

Carcass Persistence Trials

CPTs were conducted to determine the probability a bird or bat persisted through the search interval (i.e., the time between scheduled searches). These probabilities were used to adjust for the potential bias of carcasses removed between carcass searches. Possible means of carcass removal included scavenging, decomposition, or farming activities (e.g., plowing). CPTs were conducted during all seasons for all size classes (i.e. raptor, large bird, small bird, and bat) expected to be found in each season. Bat carcasses were not placed during winter, when bats are hibernating and not expected to be found.

Species used for CPTs included rock pigeons (for large birds), coturnix quail (for small birds), brown house mice (as surrogates for bats). Raptor carcasses used for CPTs included turkey vultures, red-tailed hawks, American kestrels, and Cooper's hawks. All CPT carcasses were marked with a discrete zip tie and sticker ID for recognition by searchers and other personnel, and then dropped from waist height or higher and allowed to land in a random posture.

Bat, small bird, and large bird CPT carcasses were monitored over a 30-day period. Carcasses were checked on days 1, 2, 3, 4, 7, 10, 14, 20, and 30, to the extent possible. Following the 30-day period, raptor CPTs continued to be monitored every 15 days for a total trial length of 90 days. During each check, the condition of carcasses was recorded. Following the end of the CPT period, any remaining evidence of the carcasses was removed.

Quality Assurance and Quality Control

WEST implemented quality assurance and quality control (QA/QC) measures at all stages of the study, including in the field, during data entry and analysis, and report writing. All WEST field staff were trained in proper survey and data collection techniques. Data were recorded on a tablet and data were reviewed before being submitted for data entry. If errors or discrepancies were found, follow-up measures were implemented, including discussions and review of field data with searchers and/or Project managers. WEST data entry staff were trained on proper data entry procedures. System controls were implemented to ensure correct data were entered; however, if any errors, omissions, or problems were identified in later stages of analysis, the discrepancies were traced back to the raw data where appropriate corrections were made. Data were entered into a Microsoft SQL database, and QA/QC checks of that data were implemented multiple times during the study. Statisticians provided an extra level of QA/QC to ensure proper protocols were followed and data collected were consistent with the objectives of the study. The reporting and review process included Project Management review, Technical Editing and content review, senior technical review, and a final review by the Project Manager.

Statistical Analysis

Searcher Efficiency Analysis

Data collected during SEEF trials were used to estimate the probability bird and bat carcasses were detected by searchers. Estimates were obtained for each size class separately using a logit regression model (Dalthorp et al. 2018). Season and plot type were included as potential

covariates in a set of models. The best model was selected as the most parsimonious model within two corrected Akaike Information Criterion (AICc; Burnham and Anderson 2002) units of the model with the lowest AICc value.

Carcass Persistence Analysis

Data collected during the CPTs were used to estimate how long carcasses remained available to be found and the probability that carcasses persisted through the search interval. Carcass persistence was modeled using an interval-censored survival regression for each size class using exponential, log-logistic, lognormal, and Weibull distributions (Dalthorp et al. 2018, Kalbfleisch and Prentice 2002). Covariates (explanatory variables of interest) were fit to each of the parameters of the distributions and the only covariate considered was season. The best model was selected as the most parsimonious model within two AICc units of the model with the lowest AICc value.

Detection Reduction Factor

The change in SEEF between successive searches was defined by a parameter called the detection reduction factor (*k*) that ranged from 0 to 1. When *k* is 0, it implies that a carcass missed on the first search would not be found on future searches. A *k* of 1 implies SEEF remains constant no matter how many times a carcass is missed. The detection reduction factor is a required parameter for GenEst (a generalized estimator of fatality; Dalthorp et al. 2018); however, Project-specific data were not collected to estimate *k*. Instead, a value for *k* of 0.67 estimated for bats (Huso et al. 2017) was used in this study for birds and bats.

Search Area Adjustment

The search area adjustment accounted for unsearched areas beneath turbines. Unsearched areas occurred due to limited plot size (e.g., 120-m circular plots) or obstacles (e.g., vegetation more than 12 in tall). The area adjustment was estimated as the product of the unsearched area around each turbine and a carcass-density distribution. The carcass-density distribution predicts the likelihood a carcass fell a given distance from the turbine base. For example, an area adjustment of 0.05 means that 5% of the carcasses for the species/size class were expected to fall within the search area. Separate area adjustments were estimated for eagles, large birds, small birds, and bats.

A number of analysis methods exist to calculate the search area adjustment. The method used for this analysis was determined by the number of carcasses found during surveys. For this study, there were not a sufficient number of small or large bird carcasses found during searches to use the Truncated Weighted Maximum Likelihood method. Therefore, to calculate the search area adjustment for large birds and small birds, the maximum fall distance of carcasses for a given turbine height and rotor diameter was calculated using a physics-based model (Hull and Muir 2013), where the relative carcass-density distribution was assumed to follow a linear decrease from the turbine base to the maximum predicted fall distance (Huso and Dalthorp 2014).

For bats, a Truncated Weighted Maximum Likelihood modeling approach (Khokan et al. 2013) was used to estimate the carcass-density distribution. Truncation accounts for carcasses beyond

the search radius and weighting accounts for unequal search effort. Distributions considered were normal, gamma, Gompertz, Rayleigh, and Weibull (parameterized according to Yee 2010, R Core Development Team 2020, Yee and Moler 2020). The proportion of area searched was calculated in a Geographic Information System as the amount of area searched divided by the total area searched at each 1.0-m (3.3-ft) annulus around the turbine. The area adjustment was estimated by combining the carcass-density distribution with the proportion of area searched for each 1.0-m annulus across the search area and summarizing across the distances.

Exposure Adjustment

An exposure adjustment was applied to the bald eagle detection probability to correct for changes in relative exposure observed throughout the year. This adjustment was based on bald eagle observations recorded at the Project (Table 1; Tenaska 2019). The monthly number of eagle observations were evenly distributed across the number of days in each month, resulting in a value of eagle observations per day for each day in the calendar year. The daily observations were then summed for the season dates for this Project and relativized to sum to one. The seasonal risk profile used was: spring = 0.099; summer = 0.006; fall = 0.377; winter = 0.517.

Table 1. Bald eagle observations recorded at the Project, as reported in the Clear Creek Energy Center's Eagle Conservation Plan (Tenaska 2019).

Month	Year 1	Year 2	Total
January	22	17	39
February	16	5	21
March	6	4	10
April	5	0	5
May	1	3	4
June	0	0	0
July	0	0	0
August	0	0	0
September	0	2	2
October	9	8	17
November	17	11	28
December	14	6	20

Eagle Detection Probability

The detection probability for bald eagles was determined using the raptor SEEF rates, CPT rates, and area corrections provided above, along with seasonal exposure weights based on bald eagle observations recorded at the Project. Evidence of Absence (EoA; Dalthorp et al. 2014) was used to estimate the overall detection probability ($\hat{g}$). The distribution of g is defined by a Beta distribution with two parameters, α and β. The Beta distribution parameters were estimated for each plot type within a season (EoA Single Class module), then combined within a season using the searched area (sampling fraction × area adjustment) of each plot type (on average) as weights using the EoA Multiple Class module. The seasonal Beta distributions were then combined using the exposure risk values as weights in the EoA Multiple Class module. Unsearched areas and times were assigned a detection probability distribution of nearly 0: α = 0.01 and β = 1000.

Fatality Rate Estimation

Fatality rate estimates were based on carcasses found within the search areas that had an estimated time of death within the study period. Fatality estimates were calculated for all birds, large birds, small birds, and bats using GenEst (Dalthorp et al. 2018, Simonis et al. 2018). Fatality estimates for eagles were made using Evidence of Absence (Dalthorp et al. 2014). Fatality estimates accounted for SEEF, carcass persistence, a detection reduction factor, and a search area adjustment. Estimates and confidence intervals (CI) were calculated using a parametric bootstrap (Dalthorp et al. 2018) for each individual category listed above.

RESULTS

The following sections describe the results of the carcass searches, SEEF trials, CPTs, search area adjustments, and fatality estimates. A list of the species and the scientific names is presented in Appendix A, and a full list of carcasses found during the study period is presented in Appendix B.

Standardized Carcass Searches

A total of 4,705 carcass searches were conducted from April 15, 2020, through April 14, 2021, including 3,867 road and pad searches (Table 2) and 838 circular plot searches (Table 3).

Road and Pad Searches

The average search interval for road and pad searches was seven days in spring, summer, and fall, and 30 days in winter. Thirty bird carcasses and 220 bat carcasses were found in search areas during road and pad searches. Seven bird carcasses and nine bat carcasses were not included in the analysis because these carcasses were found either outside the search area or were determined to have died outside of the study period (Table 2).

Table 2. Number and percent (%) of carcasses found during road and pad searches at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

	Included in Analysis		Outside Search Area*		Outside Study Period*		Total	
Species	**Total**	**%**	**Total**	**%**	**Total**	**%**	**Total**	**%**
Birds								
red-eyed vireo	4	17.4	0	0	0	0	4	13.3
turkey vulture	1	4.4	3	60.0	0	0	4	13.3
marsh wren**	3	13.0	0	0	0	0	3	10.0
yellow-billed cuckoo	3	13.0	0	0	0	0	3	10.0
killdeer	2	8.7	1	20.0	0	0	3	10.0
American goldfinch	1	4.4	0	0	0	0	1	3.3
blue-headed vireo	1	4.4	0	0	0	0	1	3.3
bobolink	1	4.4	0	0	0	0	1	3.3
downy woodpecker	1	4.4	0	0	0	0	1	3.3
European starling	1	4.4	0	0	0	0	1	3.3
house wren	1	4.4	0	0	0	0	1	3.3
mourning dove	1	4.4	0	0	0	0	1	3.3
northern bobwhite	1	4.4	0	0	0	0	1	3.3
red-winged blackbird	1	4.4	0	0	0	0	1	3.3
swamp sparrow	1	4.4	0	0	0	0	1	3.3
dark-eyed junco	0	0	0	0	1	50.0	1	3.3
ruby-crowned kinglet	0	0	1	20.0	0	0	1	3.3
unidentified sparrow	0	0	0	0	1	50.0	1	**3.3**
Overall Birds	**23**	**100**	**5**	**100**	**2**	**100**	**30**	**100**
Bats								
eastern red bat	78	37.0	4	50.0	0	0	82	37.3
hoary bat**	44	21.0	3	37.5	0	0	47	21.4
big brown bat	38	18.0	1	12.5	1	100	40	18.2
evening bat	38	18.0	0	0	0	0	38	17.3
silver-haired bat**	8	3.8	0	0	0	0	8	3.6
unidentified bat	3	1.4	0	0	0	0	3	1.4
tri-colored bat**	2	1	0	0	0	0	2	0.8
Overall Bats	**211**	**100**	**8**	**100**	**1**	**100**	**220**	**100**

*Carcasses were not included in the analysis.

**Species of Conservation Concern (Missouri Department of Conservation 2020)

Circular Plot Searches

The average search interval for circular plot searches was 30 days in all seasons that circular plots were searchable (e.g., when vegetation height was less than 12 in tall). Twenty bird carcasses and three bat carcasses were found in search areas during eagle-focused circular plot searches (Table 3). Because the circular plot searches were designed to estimate eagle fatality rates, only eagle carcasses were analyzed in the eagle fatality estimate. The remaining bird and bat carcasses found during the circular plot searches were not included in the analysis.

Table 3. Number and percent (%) of carcasses found during circular plot searches at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Species	Total	%
Birds		

Table 3. Number and percent (%) of carcasses found during circular plot searches at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Species	Total	%
turkey vulture	7	35.0
red-tailed hawk	5	25.0
American white pelican	1	5.0
bald eagle*	1	5.0
brown thrasher	1	5.0
house wren	1	5.0
marsh wren*	1	5.0
unidentified thrush	1	5.0
warbling vireo	1	5.0
yellow-billed cuckoo	1	5.0
Overall Birds	**20**	**100**
Bats		
silver-haired bat*	2	66.7
evening bat	1	33.3
Overall Bats	**3**	**100**

*Species of Conservation Concern (Missouri Department of Conservation 2020)

Bird Carcasses

A complete list of bird carcasses found during the study is provided in Appendix B2. Bird carcasses included in the all bird analysis were documented during searches at 19.8% of the searched turbines (Figure 6). Bird carcasses were distributed throughout the Project, showing no clear spatial trends. Bird fatalities were mostly observed from mid-spring through fall, with a peak in early summer (Figure 7).

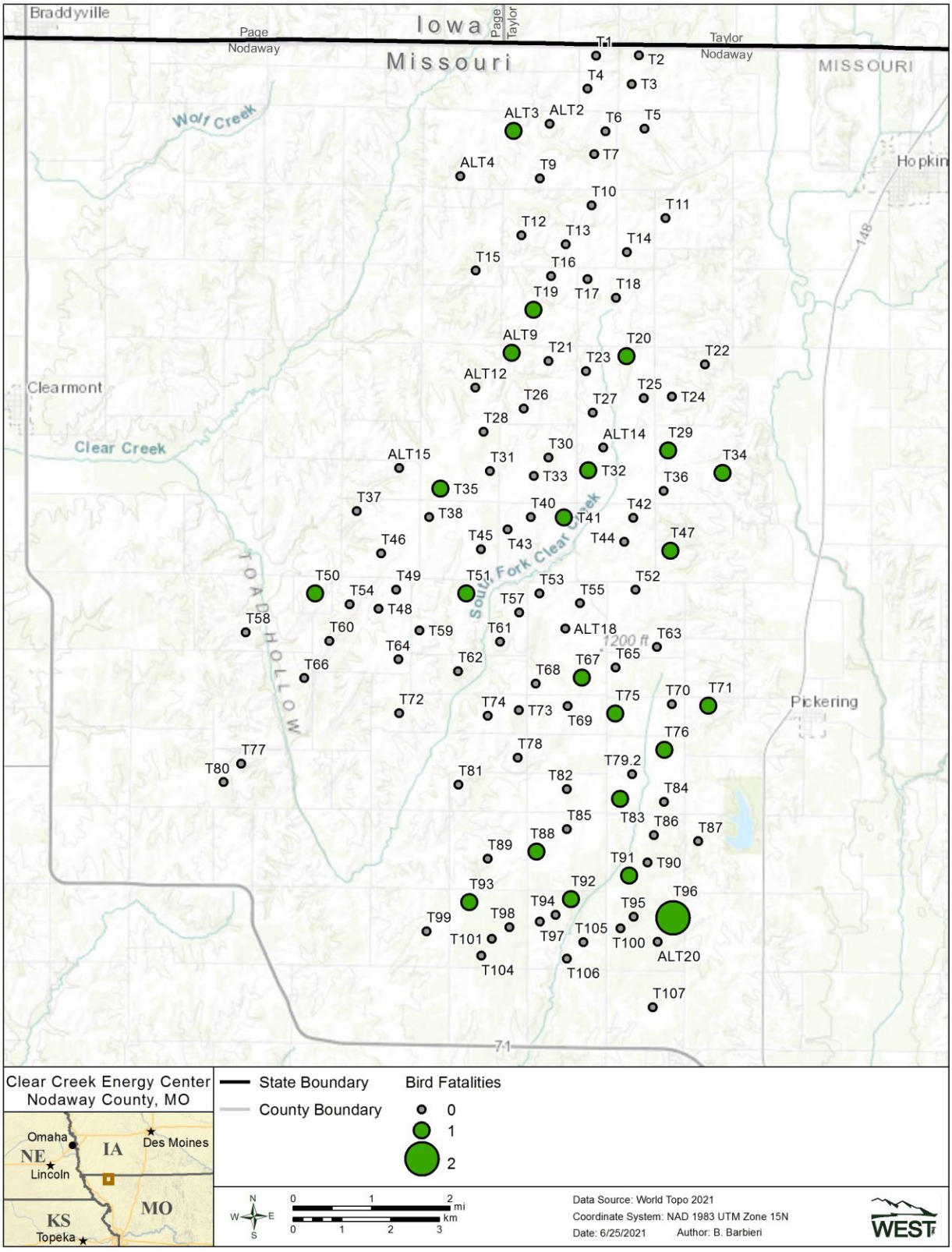

Figure 6. Location of all bird carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

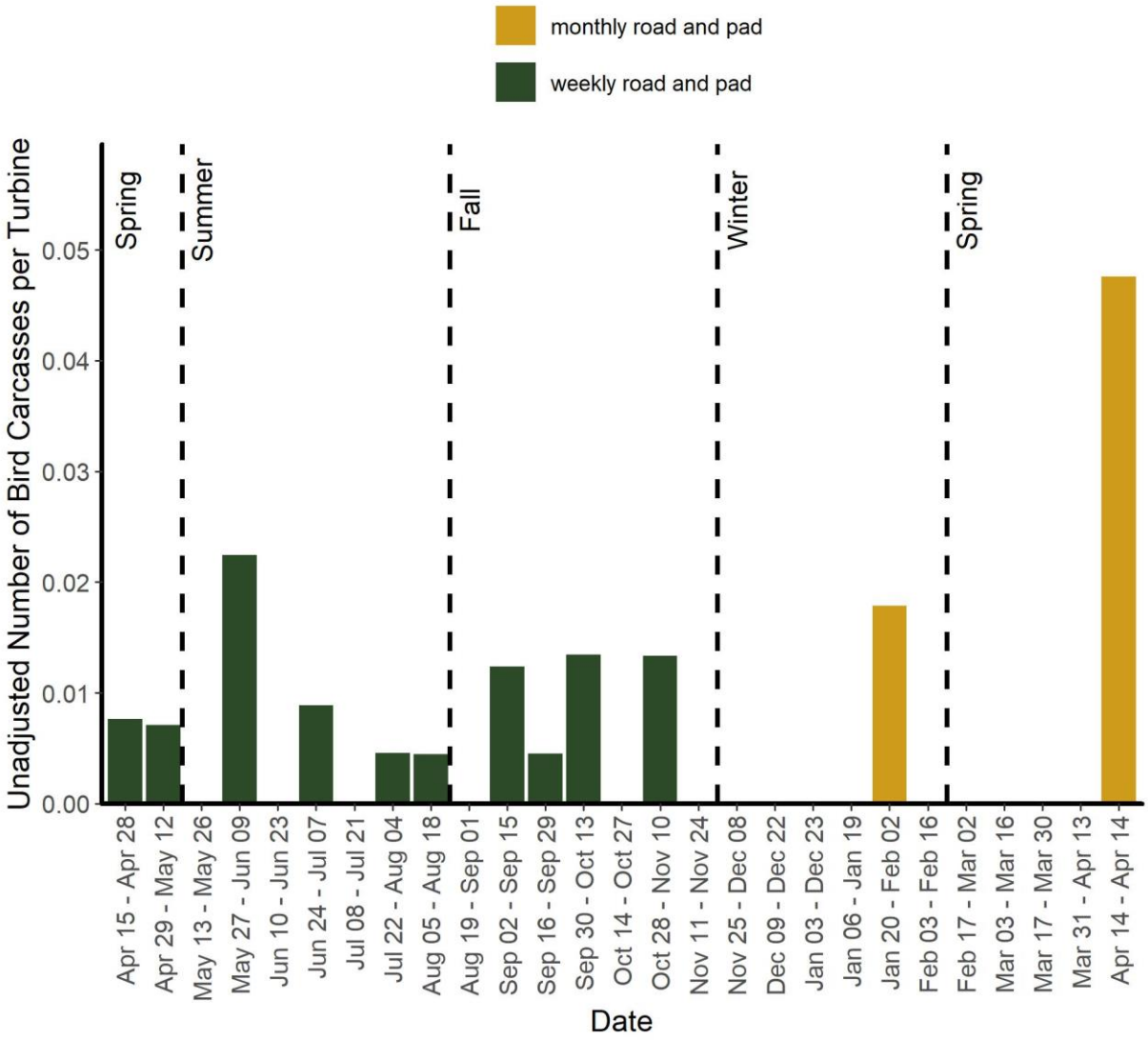

Figure 7. Temporal distribution of bird carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Bat Carcasses

During the study, 239 bat carcasses were found (Appendix B1). These included 220 carcasses found during road and pad searches (Table 2), 3 carcasses found during circular plot searches (Table 3), and 16 carcasses discovered incidentally. Of the 220 bat carcasses found during road and pad searches, 211 were included in analysis (Table 2). Bat carcasses that were included in the analysis were documented at 82.9% of the turbines spread throughout the Project (Figure 8). Bat carcasses appear to have been found more frequently at turbines in the southern portion of the Project (Figure 8). Bat fatalities were observed from April 15 – October 2, 2020 (Figure 9). The unadjusted number of bat carcasses per turbine increased through July, peaking in late July and August, before decreasing through September (Figure 9).

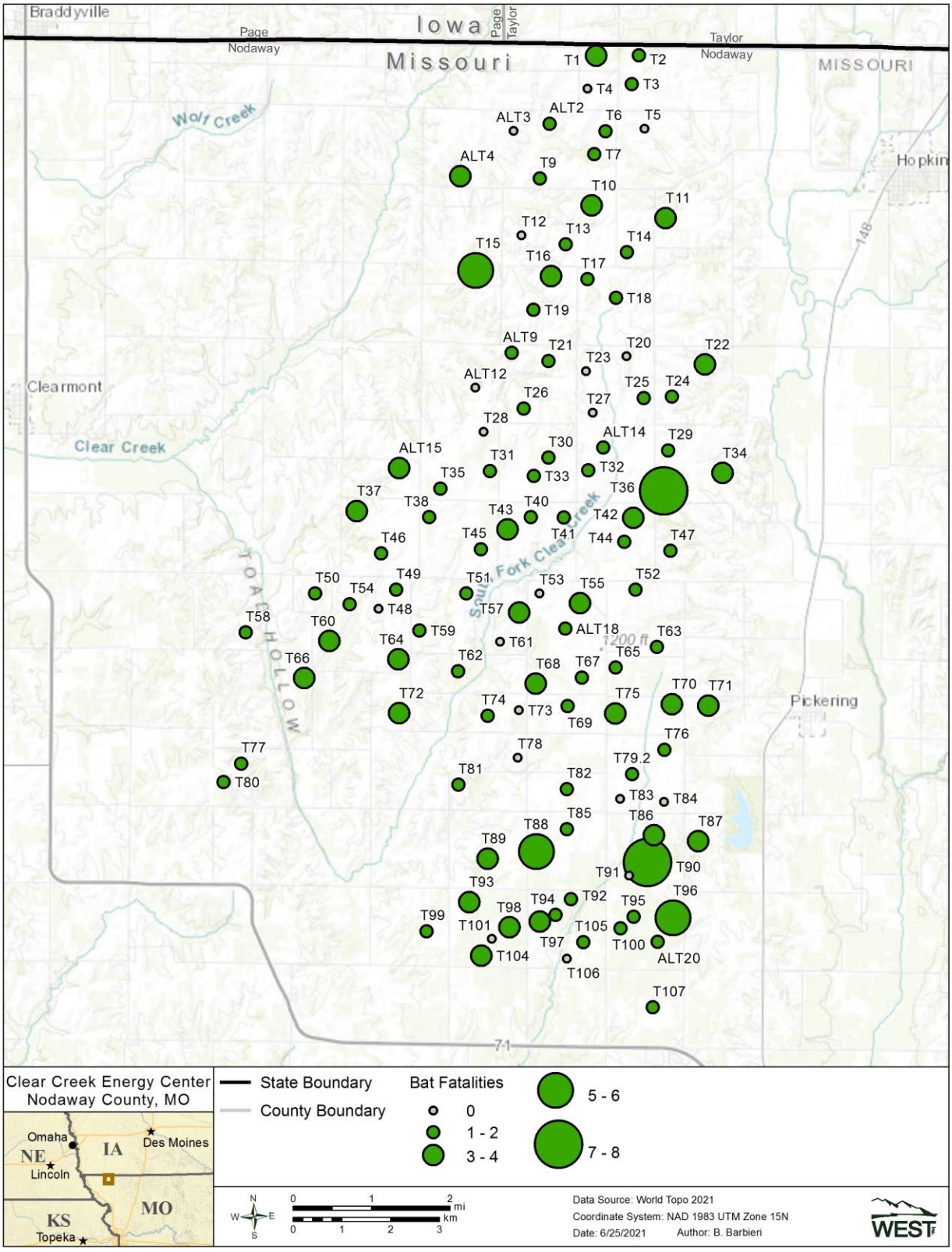

Figure 8. Location of all bat carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

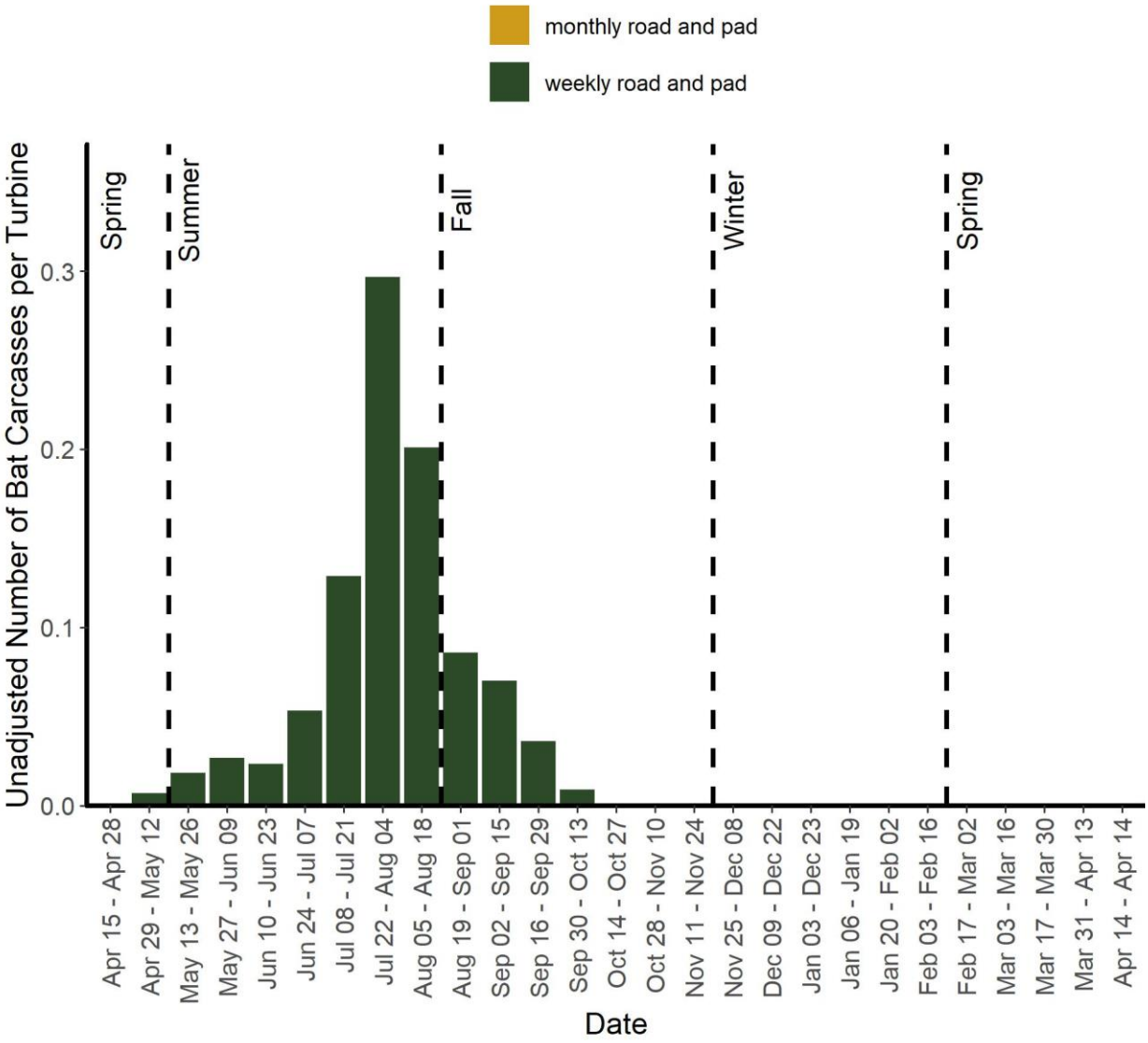

Figure 9. Temporal distribution of bat carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Searcher Efficiency Trials

SEEF trials included 269 carcasses (50 raptors, 76 large birds, 78 small birds, and 65 mice [as bat surrogates]) over the Year 1 study. Of these, 264 carcasses (50 raptors, 75 large birds, 76 small birds, and 63 mice) were confirmed to be available for the searcher to find (Table 4). During circular plot searches, searchers found 94.0% of raptor carcasses that were available to be found (Table 4). During road and pad searches, searchers found 98.7% of large bird, 85.5% of small bird, and 85.7% of bat surrogate carcasses that were available to be found (Table 4).

Table 4. Searcher efficiency results by size class at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Size Class	Plot Type	# Placed	# Available	# Found	% Found
Raptor	Circular Plot	50	50	47	94.0
Large Bird	Road and Pad	76	75	74	98.7
Small Bird	Road and Pad	78	76	65	85.5
Bat (surrogates)	Road and Pad	65	63	54	85.7

Models were fit for each size class to determine whether using season as a covariate provided the best model for estimating SEEF based on AICc values. For raptors, large birds, small birds, and bats, season was determined to not affect SEEF rates. Therefore, the estimated SEEF value was 0.94 (95% CI: 0.85–0.98) for raptors, 0.99 (90% CI: 0.93–1.00) for large birds, 0.86 (90% CI: 0.78–0.91) for small birds, and 0.86 (90% CI: 0.77–0.92) for bats (Appendix C1).

Carcass Persistence Trials

One-hundred-seventy-eight carcasses (60 raptors, 61 large birds, 60 small birds, and 51 bats [or surrogates]) were placed for the CPTs from April 15, 2020 – April 14, 2021 (Appendix D). Carcass persistence distributions based on the data collected over the 30-day CPT period were modeled over a 90-day period (Figure 10).

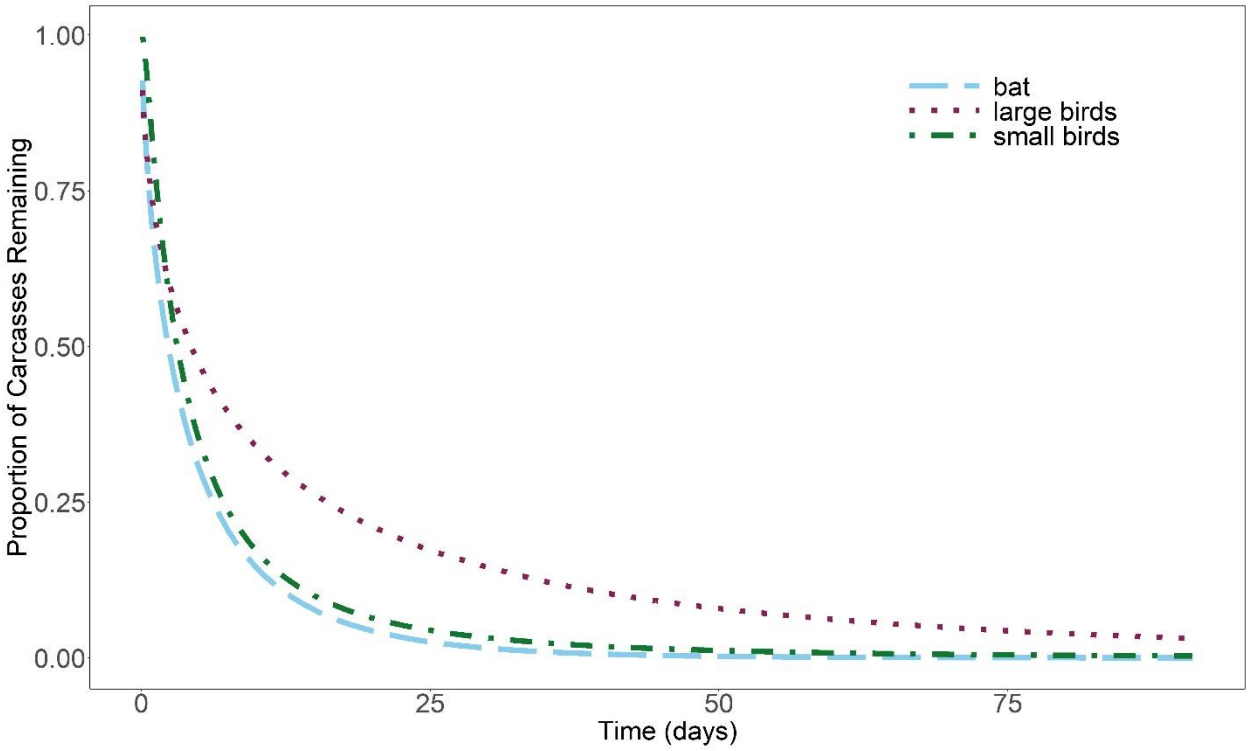

Figure 10. Carcass persistence for large bird, small bird, and bat surrogate (mouse) carcasses placed at the Clear Creek Energy Center in Nodaway County, Missouri, April 15, 2020, to April 14, 2021.

The Weibull model with no covariates provided the best fit for large bird and bat carcasses, with a predicted median removal time of 4.39 days for large birds and 2.32 days for bats (Table 5).

The log-normal model with no covariates provided the best fit for small birds, with a predicted median removal time of 3.09 days (Table 5). The average probability of a large bird, small bird, or bat carcass persisting through a 7-day search interval was 57% (90% CI: 49–66%) for large birds, 52% (90% CI: 45–60%) for small birds, and 45% (90% CI: 37–54%) for bats (Appendix C1). For raptors, the best fit model was an exponential model with season as a covariate. The predicted median removal time was 32.19 days in spring, 27.37 days in summer, 9.25 days in fall, and 32.90 days in winter (Table 6). The average probability of a raptor carcass persisting through a 30-day search interval was 74% in spring, 70% in summer, 40% in fall, and 74% in winter.

Table 5. Carcass persistence top models with covariates, distributions, and model parameters at the Clear Creek Energy Center in Nodaway County, Missouri, from June 29 – September 30, 2020.

Size Class	Distribution	Predicted Median Removal Times (Days)	Parameter 1	Parameter 2
Large Bird	Weibull*	4.39	Shape = 0.5368	Scale = 8.6972
Small Bird	Log-normal*	3.09	Mean log = 1.128	SD log = 1.227
Bat (surrogate)	Weibull*	2.32	Shape = 0.7047	Scale = 3.904

* Parameterization follows the base R parameterization for this distribution.

Table 6. Carcass persistence top models with covariates, distributions, and model parameters for the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 to April 14, 2021.

Size Class	Season	Distribution	Predicted Median Removal Times (Days)	Parameter 1
Raptor	Fall	exponential*	9.25	rate = 0.0749
Raptor	Spring	exponential*	32.19	rate = 0.0215
Raptor	Summer	exponential*	27.37	rate = 0.0253
Raptor	Winter	exponential*	32.90	rate = 0.0211

* Parameterization follows the base R parameterization for this distribution.

Search Area Adjustment

The search area adjustment for large and small birds was calculated using the Hull and Muir (2013) method (Table 7). Estimated bird carcass-density distribution was calculated using the maximum fall distance of carcasses for a 92-m (302-ft) turbine height and 62-m (203-ft) rotor radius (Hull and Muir 2013; Figure 11), where the relative carcass-density distribution was assumed to follow a linear decrease from the turbine base out to the maximum estimated fall distance (Huso and Dalthorp 2014; Figure 11). The search area adjustment for road and pad search areas was 0.10 for large birds and 0.14 for small birds (Table 7; Appendix C1).

Table 7. Area adjustment for all size classes for the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Size Class	Search Area Type	Area Adjustment
Raptor*	Circular Plot	0.91
	Road and Pad	0.02
Large Bird**	Road and Pad	0.10
Small Bird**	Road and Pad	0.14
Bat***	Road and Pad	0.05

* Based on the carcass-density distribution presented in Hallingstad et al. 2018.

** Based on the Hull and Muir distribution (Hull and Muir 2013).

*** Based on the Truncated Maximum Likelihood.

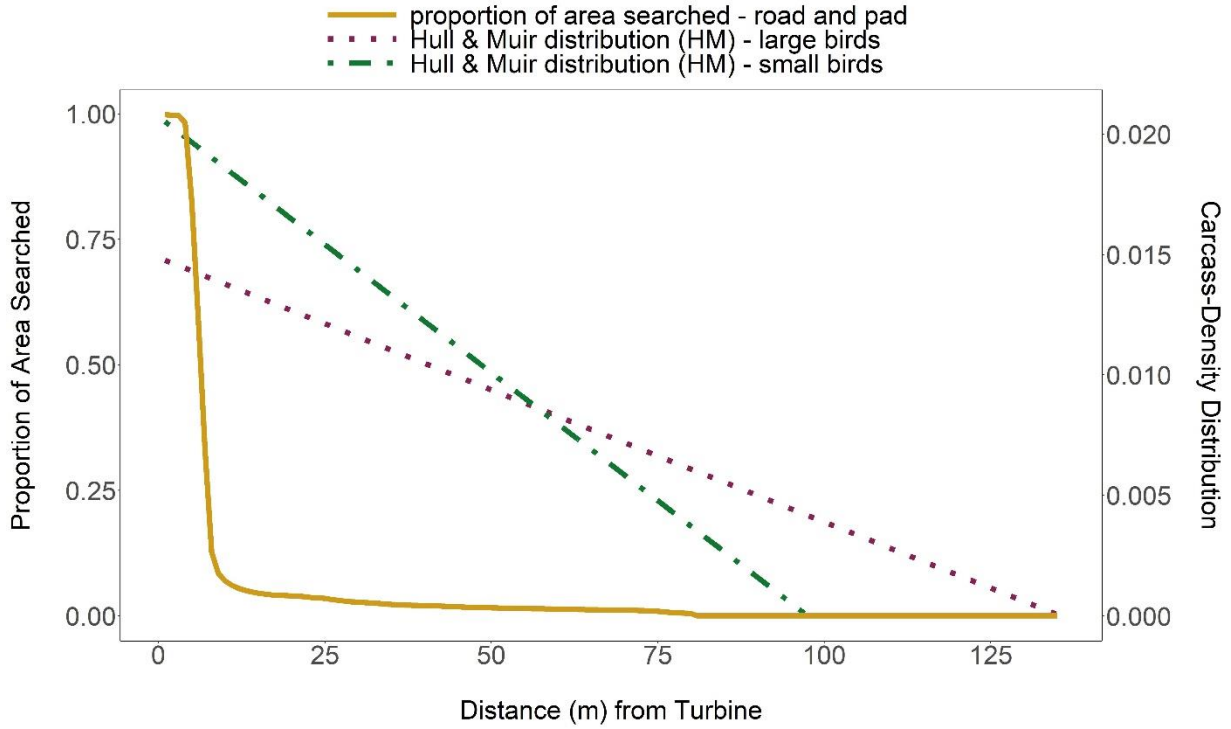

Figure 11. Estimated large bird and small bird carcass-density distribution, and proportion of area searched by distance from turbine for road and pad search areas at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Large bird and small bird area correction estimates are based on a triangular distribution using the maximum distance from Hull and Muir (2010), as presented in Figure 11 (purple and green lines). This distribution has the highest density of carcasses next to the turbine and decreases linearly to the estimated maximum distance. The proportion of area searched (Figure 11, yellow line) shows 100% of the area searched near the turbine but decreases faster than the triangle distribution for both large and small birds.

The search area adjustment for raptors was calculated using the carcass fall density distribution for raptors described by Hallingstad et al. (2018) and the observed average of proportion of area searched for circular plots and roads and pads. The Hallingstad et al. carcass fall density

distribution was used because too few raptor carcasses were found to estimate a site-specific carcass fall density distribution. Estimates were made for circular plots and roads and pads independently and the proportions of area searched accounted for unsearchable areas within the circular plots. The search area adjustment for raptors was 0.91 for circular plots and 0.02 for road and pad search areas (Table 7).

The search area adjustment model used for bats was the Truncated Weighted Maximum Likelihood modeling approach (Table 7). The best-fit distribution for the bat carcass-density distribution for road and pad searches was a normal distribution (Figure 12, and Appendix E). The search area adjustment for road and pad search areas was 0.05 for bats (Tables 7 and 8; Appendix C1), meaning that 5% of bat carcasses were expected in the road and pad search areas.

Table 8. Truncated Weighted Maximum Likelihood search area adjustment estimates at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Size Class	Search Area Type	Turbine Operation	Distribution	Parameter 1	Parameter 2	Area Correction
Bat	Road and Pad	Normal	Normal	37.0478	19.0186	0.05

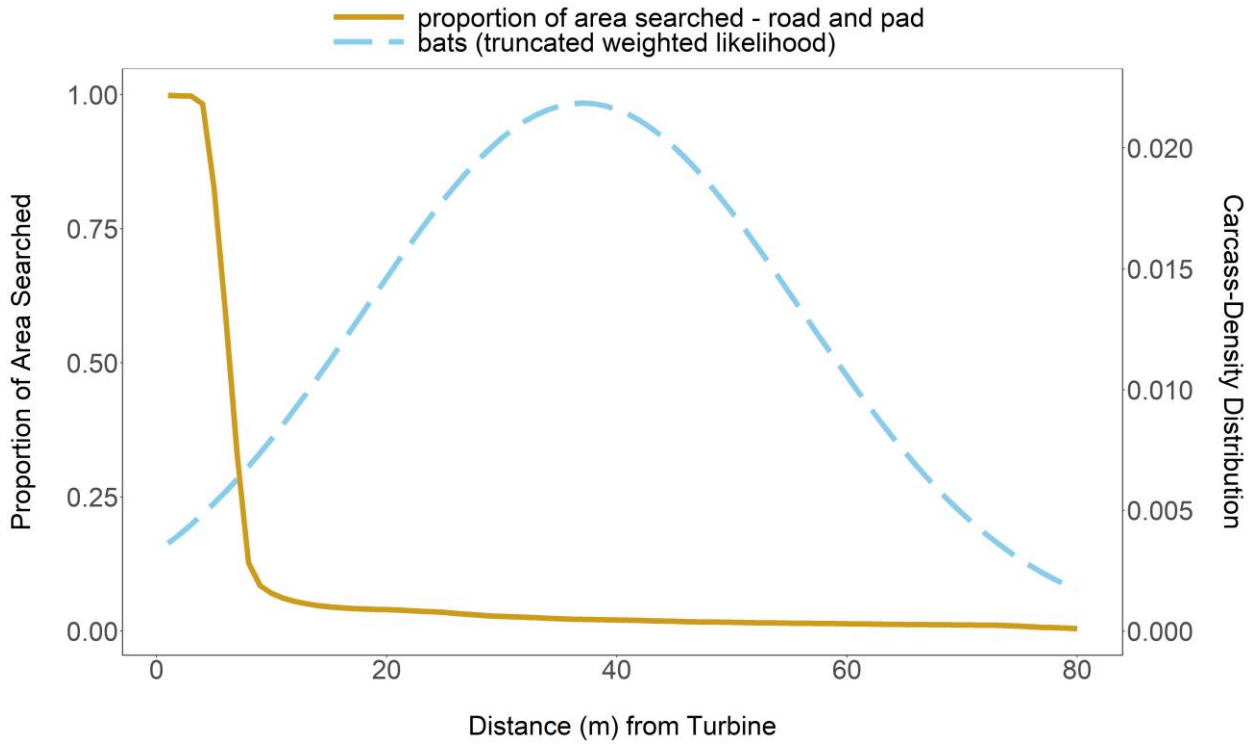

Figure 12. Estimated bat carcass-density distribution, and proportion of area searched by distance from turbine for road and pad search areas at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Exposure Adjustment

Based on the seasonal patterns of bald eagle observations recorded at the Project (Tenaska 2019), 9.9% of bald eagle exposure was expected in spring, 0.6% of bald eagle exposure was expected in summer, 37.7% of bald eagle exposure was expected in fall, and 51.7% of bald eagle exposure was expected in winter.

Eagle Detection Probability

The overall detection probability (i.e., *g*-value) attained during the study was $\hat{g}$ = 0.25 (90% CI: 0.24–0.27). The Beta distribution parameters describing the overall detection probability distribution are: α = 603.17 and β = 1801.06.

Estimated Fatality Rates

Estimated fatality rates and 90% CI were calculated per MW and per turbine for each size class (Table 9, Appendix C1). The fatality estimates were calculated based on the estimated SEEF, average probability of carcass persistence, and search area adjustment (Appendix C1). The overall estimated bird fatality rate was 1.75 bird fatalities/MW/year (3.81 bird fatalities/turbine/study period) and the overall estimated bat fatality rate was 44.72 bat fatalities/MW/study period (97.48 bat fatalities/turbine/study period; Table 9).

Table 9. Overall estimated fatality rates per megawatt (MW) and per turbine at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

	Per MW		Per Turbine	
	Estimate	**90% CI**	**Estimate**	**90% CI**
All Bird	1.75	1.13–2.58	3.81	2.47–5.62
Large Bird	0.55	0.26–0.93	1.20	0.58–2.03
Small Bird	1.17	0.67–1.90	2.55	1.46–4.15
Bat	44.72	32.28–63.29	97.48	70.36–137.98

CI = confidence interval

Using the detection probability distribution parameters reported above and the number of found bald eagle carcasses (one), the median number of mortalities to date (M*) and the annual fatality rate were estimated using EoA (Dalthorp et al. 2014). The estimated median number of mortalities to date was M* = 4. The estimated fatality rate was 5.99 bald eagles per year (90% CI = 0.7–15.62).

DISCUSSION

The results of this study demonstrate that bird and bat fatality rates at the Project are within the range of fatality rates found at wind facilities in the region (WEST 2019). The small bird and large bird fatality rates are near the lower end of the range observed in the region (WEST 2019). The estimated eagle fatality rate is below what had been predicted for the Project, as reported in the Project's draft ECP (Tenaska 2019). The Project's bat fatality estimate (47.66 bats/MW/year) is near the upper end of the range of rates observed at other facilities in the Midwest with publicly available and comparable PCM data (WEST 2019).

Bird carcasses found during the study were species commonly found in the region. Turkey vultures and red-eyed vireos accounted for the highest percentage (13.3% each) of bird carcasses found during the road and pad searches. No threatened or endangered bird species were found, although both bald eagle and marsh wren have been listed as Species of Conservation Concern in Missouri (Missouri Department of Conservation 2020).

Bat carcasses found during the study were species commonly found at wind facilities in the region (e.g. MidAmerican 2019, WEST 2019). Eastern red bats accounted for the highest percentage (37.3%) of bat carcasses found during the road and pad searches. No threatened or endangered bat species were found, although the hoary bat, silver-haired bat, and tri-colored bat have been listed as Species of Conservation Concern in Missouri (Missouri Department of Conservation 2020). Hoary bats were the second most common bat species found, accounting for 21.4% of all bat carcasses. Silver-haired bats and tri-colored bat fatalities were relatively uncommon.

The fatality rates estimated in this study were determined using the most advanced analytical methods available. These methods adjust for factors that influence the fatality estimate. Larger adjustments were made to account for relatively low carcass persistence rates and the smaller area of road and pad search areas. Median carcass persistence time for large bird, small bird, and bat size classes was less than three days, which is less than half of the average search interval during weekly searches. Median carcass persistence for raptors was less than 13 days, which is also less than half the average search interval. This raptor persistence rate, along with the monthly search interval, equates to a probability of persistence through the search interval of 0.499, which was one of the primary factors resulting in a lower detection probability for bald eagle carcasses.

All carcasses found within search areas during the study were assumed to have resulted from collision with a wind turbine and were included in the analysis. Searchers found most SEEF carcasses available to be found (94.0% of raptors, 98.7% of large birds, 85.5% of small birds, and 85.7% of bat surrogates). These rates resulted in relatively minor adjustments to the fatality rate.

The *g*-value calculated for eagle-focused searches was largely influenced by the relatively short raptor persistence along with the monthly search interval. Persistence rates can vary from year to year. Other studies in the Midwest have observed much longer raptor persistence rates. For example, raptor carcasses persisted 31.32 days at the Ida Grove Wind Energy Facility and 43.58 days at the O'Brien Wind Energy Facility (MidAmerican 2019).

In this study, potential sources of bias (Erickson 2006) were not thought to be highly influential. No signs of other potential sources of mortality were noted. Carcasses used for bias trials were believed to be representative of the target species. While gamebird carcasses were placed as part of the raptor CPTs, the final raptor persistence rate was determined using only raptor carcasses. As a result, the reported fatality estimates and confidence intervals should accurately reflect the rate of fatalities and degree of uncertainty that occurred during the study period.

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Appendix A. Common and Scientific Names of Species Found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021

Appendix A1. Species found during fatality searches at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Common Name	Scientific Name
Bird Species	
American goldfinch	*Spinus tristis*
American white pelican	*Pelecanus erythrorhynchos*
bald eagle	*Haliaeetus leucocephalus*
blue-headed vireo	*Vireo solitarius*
bobolink	*Dolichonyx oryzivorus*
brown thrasher	*Toxostoma rufum*
dark-eyed junco	*Junco hyemalis*
downy woodpecker	*Dryobates pubescens*
European starling	*Sturnus vulgaris*
house wren	*Troglodytes aedon*
killdeer	*Charadrius vociferus*
marsh wren*	*Cistothorus palustris*
mourning dove	*Zenaida macroura*
northern bobwhite	*Colinus virginianus*
red-eyed vireo	*Vireo olivaceus*
red-tailed hawk	*Buteo jamaicensis*
red-winged blackbird	*Agelaius phoeniceus*
ruby-crowned kinglet	*Regulus calendula*
swamp sparrow	*Melospiza georgiana*
turkey vulture	*Cathartes aura*
warbling vireo	*Vireo gilvus*
yellow-billed cuckoo	*Coccyzus americanus*
Bat Species	
big brown bat	*Eptesicus fuscus*
eastern red bat	*Lasiurus borealis*
evening bat	*Nycticeius humeralis*
hoary bat*	*Lasiurus cinereus*
silver-haired bat*	*Lasionycteris noctivagans*
tri-colored bat*	*Perimyotis subflavus*

* Species of Conservation Concern (Missouri Department of Conservation 2020)

Appendix B. Complete Listing of Bird and Bat Carcasses Found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021

Appendix B1. Complete listing of bird carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Found Date	Species	Distance from Turbine	Turbine	Search Type	Search Area Type	Physical Condition
04/15/2020	dark-eyed junco	68	T13	carcass search	weekly road and pad	feather spot
04/15/2020	unidentified sparrow	5	T45	carcass search	weekly road and pad	feather spot
04/16/2020	turkey vulture	10	T94	carcass search*	weekly road and pad	intact
04/19/2020	turkey vulture	27	T13	carcass search*	weekly road and pad	dismembered
04/20/2020	house wren	51	T76	carcass search	weekly road and pad	intact
04/21/2020	red-tailed hawk	81	T71	carcass search	monthly circular plot	dismembered
04/23/2020	swamp sparrow	60	T93	carcass search	weekly road and pad	scavenged
04/26/2020	turkey vulture	105	T97	carcass search	monthly circular plot	intact
04/27/2020	turkey vulture	71	ALT20	carcass search	monthly circular plot	dismembered
04/27/2020	brown thrasher	39	T98	carcass search	monthly circular plot	intact
04/28/2020	house wren	91	T76	carcass search	monthly circular plot	intact
04/29/2020	turkey vulture	26	T61	carcass search	monthly circular plot	scavenged
04/29/2020	red-tailed hawk	67	T57	carcass search	monthly circular plot	intact
05/02/2020	ruby-crowned kinglet	66	T16	carcass search*	weekly road and pad	intact
05/03/2020	marsh wren	55	T92	carcass search	weekly road and pad	intact
05/08/2020	American white pelican	90	T1	carcass search	monthly circular plot	feather spot
05/08/2020	red-tailed hawk	81	ALT4	carcass search	monthly circular plot	scavenged
05/11/2020	turkey vulture	83	T84	carcass search*	weekly road and pad	scavenged
05/12/2020	blue-headed vireo	23	ALT3	carcass search	weekly road and pad	dismembered
05/18/2020	marsh wren	94	T92	carcass search	monthly circular plot	scavenged
05/18/2020	common yellowthroat	28	T69	incidental	NA	intact
05/21/2020	yellow-billed cuckoo	28	T11	carcass search	monthly circular plot	intact
05/27/2020	red-eyed vireo	28	T32	carcass search	weekly road and pad	intact
05/28/2020	red-eyed vireo	3	T29	carcass search	weekly road and pad	intact
05/28/2020	yellow-billed cuckoo	4	T47	carcass search	weekly road and pad	intact
05/29/2020	yellow-billed cuckoo	47	T88	carcass search	weekly road and pad	intact
05/29/2020	warbling vireo	38	T104	carcass search	monthly circular plot	intact
06/02/2020	yellow-billed cuckoo	73	T41	carcass search	weekly road and pad	intact
06/05/2020	turkey vulture	22	T88	carcass search	monthly circular plot	scavenged
06/10/2020	red-tailed hawk	18	T34	carcass search	monthly circular plot	scavenged
06/17/2020	turkey vulture	28	T106	carcass search	monthly circular plot	dismembered
06/18/2020	killdeer	83	T88	carcass search*	weekly road and pad	feather spot
06/23/2020	red-tailed hawk	57	T20	carcass search	monthly circular plot	intact
06/25/2020	unidentified thrush	35	ALT20	carcass search	monthly circular plot	scavenged
06/25/2020	turkey vulture	45	T71	incidental	NA	scavenged

Appendix B1. Complete listing of bird carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Found Date	Species	Distance from Turbine	Turbine	Search Type	Search Area Type	Physical Condition
06/25/2020	killdeer	47	T58	incidental	NA	feather spot
06/30/2020	red-winged blackbird	1	T50	carcass search	weekly road and pad	intact
07/02/2020	killdeer	44	T96	carcass search	weekly road and pad	feather spot
07/24/2020	killdeer	66	T96	carcass search	weekly road and pad	feather spot
08/04/2020	eastern kingbird	277	T83	incidental	NA	intact
08/04/2020	turkey vulture	49	T5	incidental	NA	scavenged
08/05/2020	northern bobwhite	3	T67	carcass search	weekly road and pad	scavenged
08/18/2020	turkey vulture	22	T71	incidental	NA	intact
09/03/2020	red-eyed vireo	4	T35	carcass search	weekly road and pad	intact
09/04/2020	unidentified large bird	315	T99	incidental	NA	feather spot
09/08/2020	mourning dove	45	T19	carcass search	weekly road and pad	scavenged
09/15/2020	red-eyed vireo	2	ALT9	carcass search	weekly road and pad	scavenged
09/17/2020	turkey vulture	6	T34	carcass search	weekly road and pad	scavenged
10/02/2020	marsh wren	39	T91	carcass search	weekly road and pad	scavenged
10/05/2020	turkey vulture	45	T36	incidental	NA	feather spot
10/08/2020	bobolink	77	T83	carcass search	weekly road and pad	intact
10/08/2020	marsh wren	75	T75	carcass search	weekly road and pad	intact
11/02/2020	American goldfinch	23	T51	carcass search	monthly road and pad	intact
11/05/2020	turkey vulture	107	T107	carcass search	monthly circular plot	scavenged
11/20/2020	turkey vulture	93	T36	carcass search	monthly circular plot	scavenged
01/20/2021	downy woodpecker	34	T71	carcass search	monthly road and pad	intact
02/19/2021	bald eagle	26	T45	carcass search	monthly circular plot	scavenged
04/08/2021	pied-billed grebe	14	T55	incidental	NA	intact
04/14/2021	European starling	2	T20	carcass search	monthly road and pad	intact

* Carcass was found outside the search area and excluded from the analysis.

Appendix B2. Complete listing of bat carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Found Date	Species	Distance from Turbine	Turbine	Search Type	Search Area Type	Physical Condition
04/15/2020	big brown bat	36	T24	carcass search	weekly road and pad	intact
05/01/2020	eastern red bat	3	T1	carcass search	weekly road and pad	intact
05/03/2020	eastern red bat	28	T98	carcass search*	weekly road and pad	intact
05/08/2020	silver-haired bat	30	T9	carcass search	monthly circular plot	intact
05/12/2020	evening bat	4	T51	carcass search	weekly road and pad	intact
05/18/2020	evening bat	26	T105	carcass search	monthly circular plot	intact
05/18/2020	silver-haired bat	48	T95	carcass search	monthly circular plot	scavenged
05/19/2020	evening bat	4	T55	carcass search	weekly road and pad	intact
05/21/2020	hoary bat	15	T2	carcass search*	weekly road and pad	intact
05/24/2020	evening bat	4	T49	carcass search	weekly road and pad	intact
05/24/2020	hoary bat	3	T49	carcass search	weekly road and pad	intact
05/27/2020	silver-haired bat	4	T17	carcass search	weekly road and pad	intact
05/27/2020	eastern red bat	1	T63	incidental	NA	injured
05/28/2020	evening bat	5	T29	carcass search	weekly road and pad	intact
05/28/2020	hoary bat	1	T47	carcass search	weekly road and pad	intact
05/29/2020	hoary bat	32	T98	carcass search	weekly road and pad	scavenged
06/04/2020	evening bat	40	T34	carcass search	weekly road and pad	intact
06/04/2020	evening bat	6	T96	carcass search	weekly road and pad	intact
06/10/2020	eastern red bat	17	T52	carcass search	weekly road and pad	intact
06/14/2020	eastern red bat	43	T30	carcass search	weekly road and pad	scavenged
06/15/2020	eastern red bat	21	T16	carcass search	weekly road and pad	intact
06/15/2020	big brown bat	17	T107	incidental	NA	intact
06/16/2020	big brown bat	9	T71	carcass search	weekly road and pad	intact
06/18/2020	hoary bat	5	T87	carcass search	weekly road and pad	dismembered
06/24/2020	hoary bat	0	T43	carcass search	weekly road and pad	scavenged
06/25/2020	big brown bat	44	T94	carcass search	weekly road and pad	scavenged
06/25/2020	eastern red bat	24	T107	carcass search*	weekly road and pad	intact
06/29/2020	hoary bat	5	T43	carcass search	weekly road and pad	scavenged
07/02/2020	big brown bat	9	T24	carcass search	weekly road and pad	intact
07/02/2020	evening bat	9	T36	carcass search	weekly road and pad	intact
07/02/2020	hoary bat	30	T90	carcass search	weekly road and pad	intact
07/05/2020	big brown bat	5	T11	carcass search	weekly road and pad	intact
07/05/2020	big brown bat	5	T2	carcass search	weekly road and pad	intact
07/05/2020	eastern red bat	7	T11	carcass search	weekly road and pad	intact
07/05/2020	evening bat	4	ALT4	carcass search	weekly road and pad	intact
07/07/2020	hoary bat	88	T16	carcass search*	weekly road and pad	intact

Appendix B2. Complete listing of bat carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Found Date	Species	Distance from Turbine	Turbine	Search Type	Search Area Type	Physical Condition
07/07/2020	hoary bat	59	T42	carcass search	weekly road and pad	scavenged
07/07/2020	hoary bat	35	T42	carcass search	weekly road and pad	intact
07/08/2020	eastern red bat	0	T46	carcass search	weekly road and pad	intact
07/08/2020	evening bat	4	T77	carcass search	weekly road and pad	intact
07/10/2020	big brown bat	1	T89	carcass search	weekly road and pad	intact
07/10/2020	eastern red bat	31	T88	carcass search	weekly road and pad	intact
07/13/2020	hoary bat	40	T14	carcass search*	weekly road and pad	scavenged
07/14/2020	big brown bat	1	T37	carcass search	weekly road and pad	intact
07/14/2020	eastern red bat	4	T15	carcass search	weekly road and pad	intact
07/14/2020	eastern red bat	44	T15	carcass search	weekly road and pad	scavenged
07/15/2020	hoary bat	31	ALT15	carcass search	weekly road and pad	scavenged
07/16/2020	big brown bat	1	T59	carcass search	weekly road and pad	intact
07/16/2020	big brown bat	5	T71	carcass search	weekly road and pad	scavenged
07/16/2020	eastern red bat	38	T70	carcass search	weekly road and pad	scavenged
07/16/2020	hoary bat	48	T107	carcass search	weekly road and pad	scavenged
07/16/2020	hoary bat	28	T65	carcass search	weekly road and pad	intact
07/17/2020	big brown bat	18	T99	carcass search	weekly road and pad	scavenged
07/17/2020	hoary bat	2	T105	carcass search	weekly road and pad	scavenged
07/17/2020	hoary bat	12	T87	carcass search	weekly road and pad	intact
07/17/2020	eastern red bat	47	T58	incidental	NA	intact
07/20/2020	big brown bat	6	T3	carcass search	weekly road and pad	intact
07/20/2020	eastern red bat	0	ALT4	carcass search	weekly road and pad	injured
07/20/2020	eastern red bat	5	T7	carcass search	weekly road and pad	intact
07/20/2020	evening bat	21	T1	carcass search	weekly road and pad	scavenged
07/20/2020	hoary bat	3	T18	carcass search	weekly road and pad	intact
07/20/2020	hoary bat	15	T26	carcass search	weekly road and pad	intact
07/21/2020	big brown bat	37	T22	carcass search	weekly road and pad	scavenged
07/21/2020	big brown bat	4	T60	carcass search	weekly road and pad	scavenged
07/21/2020	eastern red bat	23	T15	carcass search	weekly road and pad	intact
07/21/2020	eastern red bat	34	T15	carcass search	weekly road and pad	intact
07/21/2020	eastern red bat	17	T50	carcass search	weekly road and pad	scavenged
07/21/2020	eastern red bat	6	T80	carcass search	weekly road and pad	intact
07/21/2020	evening bat	69	T19	carcass search	weekly road and pad	scavenged
07/21/2020	evening bat	19	T22	carcass search	weekly road and pad	scavenged
07/21/2020	evening bat	14	T22	carcass search	weekly road and pad	scavenged
07/22/2020	big brown bat	25	T45	carcass search	weekly road and pad	intact

Appendix B2. Complete listing of bat carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Found Date	Species	Distance from Turbine	Turbine	Search Type	Search Area Type	Physical Condition
07/22/2020	eastern red bat	4	T62	carcass search	weekly road and pad	intact
07/22/2020	evening bat	25	T57	carcass search	weekly road and pad	intact
07/23/2020	eastern red bat	15	T105	carcass search	weekly road and pad	intact
07/23/2020	eastern red bat	2	T36	carcass search	weekly road and pad	intact
07/23/2020	eastern red bat	5	T75	carcass search	weekly road and pad	intact
07/23/2020	eastern red bat	52	T75	carcass search	weekly road and pad	intact
07/23/2020	eastern red bat	8	T97	carcass search	weekly road and pad	scavenged
07/23/2020	evening bat	51	T36	carcass search	weekly road and pad	intact
07/23/2020	evening bat	29	T36	carcass search	weekly road and pad	intact
07/23/2020	hoary bat	4	T70	carcass search	weekly road and pad	intact
07/24/2020	big brown bat	1	ALT20	carcass search	weekly road and pad	scavenged
07/24/2020	big brown bat	39	T88	carcass search	weekly road and pad	scavenged
07/24/2020	eastern red bat	5	T55	carcass search	weekly road and pad	scavenged
07/24/2020	eastern red bat	4	T85	carcass search	weekly road and pad	dismembered
07/24/2020	eastern red bat	33	T88	carcass search	weekly road and pad	scavenged
07/24/2020	evening bat	1	T55	carcass search	weekly road and pad	injured
07/24/2020	evening bat	28	T86	carcass search	weekly road and pad	scavenged
07/24/2020	evening bat	32	T90	carcass search	weekly road and pad	scavenged
07/24/2020	evening bat	21	T96	carcass search	weekly road and pad	scavenged
07/24/2020	hoary bat	5	T104	carcass search	weekly road and pad	scavenged
07/24/2020	hoary bat	35	T86	carcass search	weekly road and pad	scavenged
07/24/2020	hoary bat	10	T20	incidental	NA	scavenged
07/26/2020	big brown bat	9	ALT2	carcass search	weekly road and pad	intact
07/26/2020	eastern red bat	3	T15	carcass search	weekly road and pad	scavenged
07/26/2020	eastern red bat	4	T9	carcass search	weekly road and pad	scavenged
07/26/2020	evening bat	0	T13	carcass search	weekly road and pad	intact
07/26/2020	evening bat	9	T14	carcass search	weekly road and pad	intact
07/26/2020	unidentified bat	0	T9	carcass search	weekly road and pad	scavenged
07/27/2020	big brown bat	19	T51	carcass search	weekly road and pad	intact
07/27/2020	big brown bat	7	T72	carcass search	weekly road and pad	intact
07/27/2020	eastern red bat	34	T37	carcass search	weekly road and pad	intact
07/27/2020	eastern red bat	17	T57	carcass search	weekly road and pad	intact
07/27/2020	eastern red bat	4	T60	carcass search	weekly road and pad	scavenged
07/27/2020	evening bat	7	T44	carcass search	weekly road and pad	intact
07/27/2020	hoary bat	41	T41	carcass search	weekly road and pad	intact
07/27/2020	hoary bat	29	T57	carcass search	weekly road and pad	dismembered

Appendix B2. Complete listing of bat carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Found Date	Species	Distance from Turbine	Turbine	Search Type	Search Area Type	Physical Condition
07/27/2020	unidentified bat	4	T30	carcass search	weekly road and pad	dismembered
07/28/2020	big brown bat	5	T74	carcass search	weekly road and pad	scavenged
07/28/2020	eastern red bat	32	T52	carcass search	weekly road and pad	intact
07/28/2020	eastern red bat	4	T63	carcass search	weekly road and pad	intact
07/28/2020	eastern red bat	30	T67	carcass search	weekly road and pad	scavenged
07/28/2020	evening bat	9	T24	carcass search	weekly road and pad	intact
07/28/2020	evening bat	3	T69	carcass search	weekly road and pad	intact
07/28/2020	evening bat	0	T70	carcass search	weekly road and pad	dismembered
07/28/2020	evening bat	29	T81	carcass search	weekly road and pad	intact
07/28/2020	big brown bat	26	ALT20	incidental	NA	injured
07/31/2020	big brown bat	4	T104	carcass search	weekly road and pad	scavenged
07/31/2020	big brown bat	62	T104	carcass search	weekly road and pad	scavenged
07/31/2020	eastern red bat	36	T88	carcass search	weekly road and pad	intact
07/31/2020	eastern red bat	1	T90	carcass search	weekly road and pad	scavenged
07/31/2020	hoary bat	31	T89	carcass search	weekly road and pad	scavenged
07/31/2020	big brown bat	2	T3	incidental	NA	scavenged
07/31/2020	unidentified bat	4	T3	incidental	NA	scavenged
07/31/2020	evening bat	4	T3	incidental	NA	scavenged
08/03/2020	big brown bat	55	T2	carcass search	weekly road and pad	scavenged
08/03/2020	eastern red bat	31	ALT14	carcass search	weekly road and pad	scavenged
08/03/2020	eastern red bat	55	T10	carcass search	weekly road and pad	intact
08/03/2020	eastern red bat	8	T31	carcass search*	weekly road and pad	scavenged
08/03/2020	eastern red bat	12	T32	carcass search	weekly road and pad	scavenged
08/03/2020	eastern red bat	14	T33	carcass search	weekly road and pad	intact
08/03/2020	evening bat	15	T10	carcass search	weekly road and pad	intact
08/04/2020	big brown bat	5	T72	carcass search	weekly road and pad	scavenged
08/04/2020	eastern red bat	28	T37	carcass search	weekly road and pad	scavenged
08/04/2020	eastern red bat	2	T42	carcass search	weekly road and pad	scavenged
08/04/2020	eastern red bat	3	T58	carcass search	weekly road and pad	intact
08/04/2020	eastern red bat	0	T66	carcass search	weekly road and pad	scavenged
08/04/2020	hoary bat	0	ALT9	carcass search	weekly road and pad	scavenged
08/04/2020	hoary bat	15	T17	carcass search	weekly road and pad	scavenged
08/04/2020	eastern red bat	9	T57	incidental	NA	scavenged
08/04/2020	hoary bat	9	T88	incidental	NA	scavenged
08/04/2020	eastern red bat	12	T88	incidental	NA	scavenged
08/04/2020	hoary bat	0	T57	incidental	NA	intact

Appendix B2. Complete listing of bat carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Found Date	Species	Distance from Turbine	Turbine	Search Type	Search Area Type	Physical Condition
08/05/2020	eastern red bat	4	T35	carcass search	weekly road and pad	intact
08/05/2020	evening bat	16	T64	carcass search	weekly road and pad	intact
08/05/2020	evening bat	25	T64	carcass search	weekly road and pad	intact
08/05/2020	silver-haired bat	12	T64	carcass search	weekly road and pad	scavenged
08/05/2020	hoary bat	30	T73	incidental	NA	scavenged
08/06/2020	eastern red bat	1	ALT18	carcass search	weekly road and pad	intact
08/06/2020	evening bat	4	T63	carcass search	weekly road and pad	scavenged
08/07/2020	eastern red bat	18	T89	carcass search	weekly road and pad	scavenged
08/07/2020	evening bat	45	T104	carcass search	weekly road and pad	intact
08/07/2020	hoary bat	3	T90	carcass search	weekly road and pad	scavenged
08/07/2020	hoary bat	38	T98	carcass search	weekly road and pad	scavenged
08/10/2020	big brown bat	20	ALT4	carcass search	weekly road and pad	intact
08/10/2020	eastern red bat	6	T40	carcass search	weekly road and pad	scavenged
08/10/2020	eastern red bat	72	T92	carcass search*	weekly road and pad	intact
08/11/2020	big brown bat	4	T16	carcass search	weekly road and pad	intact
08/11/2020	big brown bat	29	T54	carcass search	weekly road and pad	intact
08/11/2020	eastern red bat	13	T1	carcass search	weekly road and pad	intact
08/11/2020	eastern red bat	32	T16	carcass search	weekly road and pad	scavenged
08/11/2020	eastern red bat	5	T19	carcass search	weekly road and pad	dismembered
08/11/2020	eastern red bat	40	T58	carcass search	weekly road and pad	scavenged
08/11/2020	eastern red bat	3	T72	carcass search	weekly road and pad	dismembered
08/11/2020	evening bat	2	T77	carcass search	weekly road and pad	intact
08/12/2020	big brown bat	4	T82	carcass search	weekly road and pad	intact
08/12/2020	eastern red bat	3	ALT15	carcass search	weekly road and pad	injured
08/12/2020	eastern red bat	4	T35	carcass search	weekly road and pad	intact
08/12/2020	eastern red bat	22	T81	carcass search	weekly road and pad	intact
08/12/2020	eastern red bat	17	T95	incidental	NA	intact
08/13/2020	big brown bat	5	T34	carcass search	weekly road and pad	scavenged
08/13/2020	big brown bat	5	T47	carcass search	weekly road and pad	intact
08/13/2020	eastern red bat	19	T100	carcass search	weekly road and pad	scavenged
08/13/2020	eastern red bat	28	T25	carcass search	weekly road and pad	scavenged
08/13/2020	eastern red bat	24	T97	carcass search	weekly road and pad	intact
08/13/2020	evening bat	0	T36	carcass search	weekly road and pad	injured
08/13/2020	hoary bat	44	T36	carcass search	weekly road and pad	intact
08/13/2020	hoary bat	41	T36	carcass search	weekly road and pad	intact
08/13/2020	hoary bat	50	T75	carcass search	weekly road and pad	intact

Appendix B2. Complete listing of bat carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Found Date	Species	Distance from Turbine	Turbine	Search Type	Search Area Type	Physical Condition
08/13/2020	hoary bat	27	T95	carcass search	weekly road and pad	intact
08/13/2020	tri-colored bat	34	T36	carcass search	weekly road and pad	intact
08/14/2020	big brown bat	1	T88	carcass search	weekly road and pad	intact
08/14/2020	big brown bat	6	T93	carcass search	weekly road and pad	scavenged
08/14/2020	eastern red bat	29	T86	carcass search	weekly road and pad	scavenged
08/14/2020	eastern red bat	69	T93	carcass search	weekly road and pad	intact
08/14/2020	tri-colored bat	10	T88	carcass search	weekly road and pad	intact
08/17/2020	big brown bat	110	ALT4	carcass search*	weekly road and pad	scavenged
08/17/2020	big brown bat	0	T7	carcass search	weekly road and pad	scavenged
08/17/2020	eastern red bat	4	T10	carcass search	weekly road and pad	scavenged
08/17/2020	evening bat	40	T6	carcass search	weekly road and pad	intact
08/18/2020	big brown bat	4	T22	carcass search	weekly road and pad	intact
08/18/2020	evening bat	6	T80	carcass search	weekly road and pad	intact
08/19/2020	big brown bat	40	T43	carcass search	weekly road and pad	scavenged
08/19/2020	big brown bat	3	T45	carcass search	weekly road and pad	intact
08/19/2020	eastern red bat	4	T68	carcass search	weekly road and pad	intact
08/19/2020	eastern red bat	3	T79.2	carcass search	weekly road and pad	scavenged
08/19/2020	evening bat	7	T64	carcass search	weekly road and pad	intact
08/20/2020	hoary bat	11	T93	carcass search	weekly road and pad	intact
08/21/2020	big brown bat	9	ALT20	carcass search	weekly road and pad	dismembered
08/21/2020	eastern red bat	9	T87	carcass search	weekly road and pad	intact
08/21/2020	eastern red bat	61	T90	carcass search	weekly road and pad	scavenged
08/21/2020	eastern red bat	30	T90	carcass search	weekly road and pad	intact
08/21/2020	evening bat	46	T11	carcass search	weekly road and pad	scavenged
08/21/2020	hoary bat	23	T90	carcass search	weekly road and pad	dismembered
08/24/2020	big brown bat	23	T14	carcass search	weekly road and pad	scavenged
08/25/2020	eastern red bat	2	T42	carcass search	weekly road and pad	intact
08/25/2020	eastern red bat	9	T60	carcass search	weekly road and pad	intact
08/27/2020	eastern red bat	6	T89	carcass search	weekly road and pad	intact
08/27/2020	eastern red bat	0	T97	carcass search	weekly road and pad	scavenged
09/02/2020	eastern red bat	3	T66	carcass search	weekly road and pad	intact
09/03/2020	hoary bat	3	T38	carcass search	weekly road and pad	dismembered
09/03/2020	silver-haired bat	6	T71	carcass search	weekly road and pad	dismembered
09/04/2020	eastern red bat	54	T76	carcass search	weekly road and pad	scavenged
09/04/2020	hoary bat	18	T85	carcass search	weekly road and pad	intact
09/04/2020	silver-haired bat	35	T98	carcass search	weekly road and pad	dismembered

Appendix B2. Complete listing of bat carcasses found at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Found Date	Species	Distance from Turbine	Turbine	Search Type	Search Area Type	Physical Condition
09/07/2020	eastern red bat	63	ALT2	carcass search	weekly road and pad	scavenged
09/08/2020	hoary bat	0	T66	carcass search	weekly road and pad	intact
09/09/2020	eastern red bat	21	T82	carcass search	weekly road and pad	intact
09/09/2020	hoary bat	9	T43	carcass search	weekly road and pad	intact
09/09/2020	big brown bat	3	T44	incidental	NA	intact
09/10/2020	hoary bat	1	T34	carcass search	weekly road and pad	scavenged
09/10/2020	big brown bat	63	T107	incidental	NA	dismembered
09/11/2020	hoary bat	7	T54	carcass search	weekly road and pad	intact
09/11/2020	hoary bat	63	T96	carcass search	weekly road and pad	dismembered
09/14/2020	hoary bat	0	T31	carcass search	weekly road and pad	scavenged
09/14/2020	silver-haired bat	4	T3	carcass search	weekly road and pad	scavenged
09/15/2020	hoary bat	2	T21	carcass search	weekly road and pad	scavenged
09/15/2020	silver-haired bat	5	T37	carcass search	weekly road and pad	intact
09/16/2020	eastern red bat	67	ALT15	carcass search	weekly road and pad	intact
09/16/2020	hoary bat	0	T68	carcass search	weekly road and pad	intact
09/16/2020	hoary bat	6	T68	carcass search	weekly road and pad	intact
09/21/2020	hoary bat	3	ALT14	carcass search	weekly road and pad	scavenged
09/23/2020	silver-haired bat	37	ALT15	carcass search	weekly road and pad	intact
09/24/2020	eastern red bat	59	T92	carcass search	weekly road and pad	intact
09/24/2020	eastern red bat	11	T94	carcass search	weekly road and pad	intact
09/25/2020	eastern red bat	25	T93	carcass search	weekly road and pad	scavenged
10/02/2020	silver-haired bat	17	T96	carcass search	weekly road and pad	intact
10/02/2020	unidentified bat	0	T96	carcass search	weekly road and pad	injured

* Carcass was found outside the search area and excluded from the analysis.

Appendix C. Bird and Bat Fatality Rates and Adjustment Factors Tables at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021

Appendix C1. Estimated fatality rates and adjustment factors, with 90% confidence intervals at for all plots search areas for studies conducted at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 to April 14, 2021.

	Spring 2020		Summer		Fall		Winter		Spring 2021		Spring Combined	
	Estimate	90% CI	Estimate	90% CI	Estimate	90% CI	Estimate	90% CI	Estimate	90% CI	Estimate	90% CI
Search Area Adjustment												
Large Bird	0.10	-	0.10	-	0.10	-	0.10	-	0.10	-		
Small Bird	0.14	-	0.14	-	0.14	-	0.14	-	0.14	-		
Bat	0.05	0.04–0.06	0.05	0.04–0.06	0.05	0.04–0.06	-	-	0.05	0.04–0.06		
Searcher Efficiency												
Large Bird	0.99	0.93–1.00	0.99	0.93–1.00	0.99	0.93–1.00	0.99	0.93–1.00	0.99	0.93–1.00		
Small Bird	0.86	0.78–0.91	0.86	0.78–0.91	0.86	0.78–0.91	0.86	0.78–0.91	0.86	0.78–0.91		
Bat	0.86	0.77–0.92	0.86	0.77–0.92	0.86	0.77–0.92	-	-	0.86	0.77–0.92		
Average Probability of a Carcass Persisting Through the Search Interval**												
Large Bird	0.57	0.49–0.66	0.57	0.50–0.66	0.57	0.49–0.66	0.32	0.25–0.40	0.32	0.24–0.39		
Small Bird	0.52	0.45–0.59	0.52	0.44–0.60	0.52	0.45–0.60	0.19	0.14–0.24	0.19	0.14–0.24		
Bat	0.45	0.37–0.54	0.45	0.37–0.54	0.45	0.37–0.54	-	-	0.16	0.12–0.21		
Probability of Available and Detected												
Large Bird	0.51	0.42–0.60	0.51	0.42–0.60	0.51	0.42–0.60	0.51	0.42–0.60	0.51	0.42–0.60		
Small Bird	0.38	0.31–0.44	0.38	0.31–0.44	0.38	0.31–0.44	0.38	0.31–0.44	0.38	0.31–0.44		
Bat	0.32	0.25–0.40	0.32	0.25–0.40	0.32	0.25–0.40	-	-	0.32	0.25–0.40		
Estimated Fatality Rates (Fatalities/Turbine/Seasons(s))												
All Bird	0.45	n/a*	1.40	0.73–2.34	1.06	0.50–1.74	0.45	n/a*	0.37	n/a*	0.81	0.23–1.79
Large Bird	0	n/a*	0.91	0.34–1.67	0.28	n/a*	0	n/a*	0	n/a*	0	n/a*
Small Bird	0.45	n/a*	0.45	n/a*	0.79	0.31–1.41	0.45	n/a*	0.37	n/a*	0.81	0.23–1.79
Bat	0.85	n/a*	84.27	61.24–118.35	11.83	7.37–18.18	0	n/a*	0	n/a*	0.85	n/a*
Estimated Fatality Rates (Fatalities/MW/Seasons(s))												
All Bird	0.21	n/a*	0.64	0.33–1.07	0.49	0.23–0.80	0.21	n/a*	0.17	n/a*	0.37	0.11–0.82
Large Bird	0	n/a*	0.42	0.16–0.77	0.13	n/a*	0	n/a*	0	n/a*	0	n/a*
Small Bird	0.21	n/a*	0.21	n/a*	0.36	0.14–0.65	0.21	n/a*	0.17	n/a*	0.37	0.11–0.82
Bat	0.39	n/a*	38.66	28.09–54.29	5.43	3.38–8.34	0	n/a*	0	n/a*	0.39	n/a*

* Confidence interval not calculated because there were fewer than five carcasses found.

** The search interval was weekly from spring 2020 through fall 2020, and then monthly in winter and spring 2021.

Appendix C2. Searcher efficiency models for the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Type	Number of SEEF Trials	Covariates	AICc	Delta AICc
Large Birds	75	No Covariates	12.68	0*
Small Birds	76	No Covariates	64.90	0*
Bats (surrogates)	63	No Covariates	53.74	0*

* Selected model

AICc = corrected Akaike Information Criterion, SEEF = searcher efficiency

Delta AICc is the change from the minimum AICc

Appendix D. Carcass Persistence Trial Information at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021

Appendix D1. All carcasses placed for carcass persistence trials by date, season, species, and turbine at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Date Placed	Season	Species	Turbine	*Before Removal	**After Removal
04/16/2020	Spring	turkey vulture	T94	06/14/2020	06/29/2020
04/19/2020	Spring	turkey vulture	T13	05/09/2020	05/19/2020
04/20/2020	Spring	coturnix quail	T33	04/24/2020	04/27/2020
04/20/2020	Spring	coturnix quail	T11	04/24/2020	04/27/2020
04/20/2020	Spring	coturnix quail	T76	04/27/2020	04/29/2020
04/20/2020	Spring	coturnix quail	T100	04/27/2020	04/29/2020
04/20/2020	Spring	coturnix quail	T5	04/21/2020	04/21/2020
04/20/2020	Spring	mouse	T7	04/24/2020	04/27/2020
04/20/2020	Spring	rock pigeon	T40	04/21/2020	04/21/2020
04/20/2020	Spring	rock pigeon	T52	05/03/2020	05/09/2020
04/20/2020	Spring	rock pigeon	T24	04/21/2020	04/21/2020
04/20/2020	Spring	rock pigeon	T2	05/10/2020	05/20/2020
04/20/2020	Spring	rock pigeon	T4	04/21/2020	04/24/2020
04/20/2020	Spring	unidentified bat	T104	04/29/2020	05/03/2020
04/20/2020	Spring	unidentified bat	T79.2	04/21/2020	04/23/2020
04/20/2020	Spring	unidentified bat	T55	04/22/2020	04/24/2020
04/20/2020	Spring	unidentified bat	T20	04/24/2020	04/29/2020
04/26/2020	Spring	red-tailed hawk	T57	05/18/2020	05/28/2020
04/26/2020	Spring	turkey vulture	T97	06/10/2020	06/24/2020
05/18/2020	Summer	coturnix quail	T3	05/18/2020	05/20/2020
05/18/2020	Summer	coturnix quail	T96	05/18/2020	05/19/2020
05/18/2020	Summer	coturnix quail	T36	05/22/2020	05/24/2020
05/18/2020	Summer	coturnix quail	T11	05/22/2020	05/24/2020
05/18/2020	Summer	coturnix quail	T51	05/24/2020	05/28/2020
05/18/2020	Summer	coturnix quail	T80	06/16/2020	06/16/2020
05/18/2020	Summer	mouse	T45	05/18/2020	05/18/2020
05/18/2020	Summer	mouse	T81	05/18/2020	05/18/2020
05/18/2020	Summer	mouse	T76	05/27/2020	05/31/2020
05/18/2020	Summer	rock pigeon	T69	05/19/2020	05/19/2020
05/18/2020	Summer	rock pigeon	T15	05/19/2020	05/20/2020
05/18/2020	Summer	rock pigeon	T33	05/20/2020	05/22/2020
05/18/2020	Summer	rock pigeon	T79.2	05/23/2020	05/25/2020
05/18/2020	Summer	rock pigeon	T29	05/22/2020	05/24/2020
05/18/2020	Summer	rock pigeon	T99	06/08/2020	06/17/2020
05/18/2020	Summer	rock pigeon	T42	05/24/2020	05/27/2020
05/18/2020	Summer	unidentified bat	ALT9	05/18/2020	05/18/2020
05/18/2020	Summer	unidentified bat	T46	05/24/2020	05/28/2020
06/01/2020	Spring	red-tailed hawk	T27	06/08/2020	06/11/2020
06/01/2020	Spring	red-tailed hawk	T9	06/14/2020	06/22/2020
06/01/2020	Spring	red-tailed hawk	T14	06/14/2020	06/22/2020
06/01/2020	Spring	red-tailed hawk	T50	08/27/2020	08/27/2020
06/22/2020	Summer	coturnix quail	T54	06/22/2020	06/23/2020
06/22/2020	Summer	coturnix quail	T34	06/24/2020	06/25/2020
06/22/2020	Summer	coturnix quail	T107	06/24/2020	06/25/2020
06/22/2020	Summer	coturnix quail	T16	06/23/2020	06/24/2020
06/22/2020	Summer	coturnix quail	T89	06/25/2020	06/29/2020
06/22/2020	Summer	mouse	T50	06/22/2020	06/22/2020
06/22/2020	Summer	mouse	T93	06/22/2020	06/23/2020
06/22/2020	Summer	mouse	ALT4	06/24/2020	06/25/2020
06/22/2020	Summer	mouse	T25	06/22/2020	06/24/2020
06/22/2020	Summer	mouse	T66	06/25/2020	06/28/2020

Appendix D1. All carcasses placed for carcass persistence trials by date, season, species, and turbine at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Date Placed	Season	Species	Turbine	*Before Removal	**After Removal
06/22/2020	Summer	rock pigeon	T78	06/24/2020	06/25/2020
06/22/2020	Summer	rock pigeon	T52	06/25/2020	06/29/2020
06/22/2020	Summer	rock pigeon	T31	06/25/2020	06/28/2020
06/22/2020	Summer	rock pigeon	T100	07/10/2020	07/10/2020
06/22/2020	Summer	rock pigeon	T10	07/21/2020	07/21/2020
07/12/2020	Summer	mouse	T1	07/13/2020	07/14/2020
07/13/2020	Summer	coturnix quail	T37	07/14/2020	07/15/2020
07/13/2020	Summer	coturnix quail	T63	07/14/2020	07/15/2020
07/13/2020	Summer	coturnix quail	T58	07/13/2020	07/16/2020
07/13/2020	Summer	coturnix quail	T5	07/14/2020	07/15/2020
07/13/2020	Summer	mouse	T24	07/14/2020	07/14/2020
07/13/2020	Summer	mouse	T28	07/14/2020	07/15/2020
07/13/2020	Summer	mouse	T99	07/14/2020	07/15/2020
07/13/2020	Summer	mouse	T6	07/14/2020	07/15/2020
07/13/2020	Summer	rock pigeon	T41	07/14/2020	07/14/2020
07/13/2020	Summer	rock pigeon	T100	07/14/2020	07/15/2020
07/13/2020	Summer	rock pigeon	T23	07/14/2020	07/15/2020
07/13/2020	Summer	rock pigeon	T7	07/16/2020	07/19/2020
08/18/2020	Summer	turkey vulture	T71	11/15/2020	11/15/2020
08/24/2020	Summer	coturnix quail	T38	08/24/2020	08/24/2020
08/24/2020	Summer	coturnix quail	ALT2	08/25/2020	08/25/2020
08/24/2020	Summer	coturnix quail	T17	08/25/2020	08/25/2020
08/24/2020	Summer	coturnix quail	T62	08/24/2020	08/25/2020
08/24/2020	Summer	coturnix quail	T6	08/25/2020	08/25/2020
08/24/2020	Summer	coturnix quail	T41	08/24/2020	08/25/2020
08/24/2020	Summer	mouse	T16	08/25/2020	08/26/2020
08/24/2020	Summer	mouse	T4	08/25/2020	08/25/2020
08/24/2020	Summer	mouse	T20	08/25/2020	08/25/2020
08/24/2020	Summer	mouse	T71	08/30/2020	09/02/2020
08/24/2020	Summer	mouse	T89	09/06/2020	09/13/2020
08/24/2020	Summer	mouse	T57	09/06/2020	09/22/2020
08/24/2020	Summer	rock pigeon	T106	08/24/2020	08/24/2020
08/24/2020	Summer	rock pigeon	T83	08/24/2020	08/25/2020
08/24/2020	Summer	rock pigeon	T49	08/24/2020	08/24/2020
08/24/2020	Summer	rock pigeon	T48	08/24/2020	08/24/2020
08/24/2020	Summer	rock pigeon	T33	09/03/2020	09/06/2020
08/24/2020	Summer	rock pigeon	T13	09/22/2020	09/22/2020
09/07/2020	Summer	red-tailed hawk	T58	09/07/2020	09/07/2020
09/07/2020	Summer	red-tailed hawk	T91	09/11/2020	09/14/2020
09/07/2020	Summer	red-tailed hawk	T28	09/16/2020	09/21/2020
09/07/2020	Summer	red-tailed hawk	T13	10/06/2020	10/22/2020
09/07/2020	Summer	red-tailed hawk	T68	10/22/2020	11/06/2020
09/21/2020	Fall	coturnix quail	T7	09/21/2020	09/22/2020
09/21/2020	Fall	coturnix quail	T23	09/21/2020	09/22/2020
09/21/2020	Fall	coturnix quail	T36	09/21/2020	09/23/2020
09/21/2020	Fall	mouse	T14	09/21/2020	09/21/2020
09/21/2020	Fall	mouse	ALT14	09/21/2020	09/22/2020
09/21/2020	Fall	mouse	T24	09/30/2020	10/05/2020
09/21/2020	Fall	rock pigeon	T21	09/21/2020	09/21/2020
09/21/2020	Fall	rock pigeon	T18	09/21/2020	09/21/2020
09/21/2020	Fall	rock pigeon	T6	09/21/2020	09/22/2020

Appendix D1. All carcasses placed for carcass persistence trials by date, season, species, and turbine at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Date Placed	Season	Species	Turbine	*Before Removal	**After Removal
09/21/2020	Fall	rock pigeon	T32	09/22/2020	09/22/2020
10/05/2020	Fall	American kestrel	T24	10/05/2020	10/06/2020
10/05/2020	Fall	red-tailed hawk	ALT18	10/05/2020	10/05/2020
10/05/2020	Fall	red-tailed hawk	T63	10/05/2020	10/06/2020
10/05/2020	Fall	red-tailed hawk	ALT15	10/05/2020	10/06/2020
10/05/2020	Fall	red-tailed hawk	T67	10/06/2020	10/07/2020
10/12/2020	Fall	coturnix quail	T36	10/12/2020	10/12/2020
10/12/2020	Fall	coturnix quail	T49	10/13/2020	10/13/2020
10/12/2020	Fall	coturnix quail	T93	10/14/2020	10/14/2020
10/12/2020	Fall	coturnix quail	T78	10/14/2020	10/15/2020
10/12/2020	Fall	coturnix quail	T64	10/15/2020	10/19/2020
10/12/2020	Fall	coturnix quail	T22	10/18/2020	10/22/2020
10/12/2020	Fall	mouse	T20	10/12/2020	10/12/2020
10/12/2020	Fall	mouse	T52	10/13/2020	10/13/2020
10/12/2020	Fall	mouse	T99	10/13/2020	10/13/2020
10/12/2020	Fall	mouse	T50	10/13/2020	10/14/2020
10/12/2020	Fall	mouse	T62	10/13/2020	10/13/2020
10/12/2020	Fall	mouse	T24	10/22/2020	11/10/2020
10/12/2020	Fall	mouse	T88	10/26/2020	11/02/2020
10/12/2020	Fall	rock pigeon	T29	10/12/2020	10/12/2020
10/12/2020	Fall	rock pigeon	T60	10/13/2020	10/14/2020
10/12/2020	Fall	rock pigeon	T73	10/14/2020	10/15/2020
10/12/2020	Fall	rock pigeon	T89	10/22/2020	10/26/2020
10/12/2020	Fall	rock pigeon	T51	10/26/2020	11/02/2020
11/02/2020	Fall	Cooper's hawk	T15	11/20/2020	12/01/2020
11/02/2020	Fall	red-tailed hawk	ALT20	11/02/2020	11/02/2020
11/02/2020	Fall	red-tailed hawk	T83	11/06/2020	11/08/2020
11/02/2020	Fall	red-tailed hawk	T24	11/04/2020	11/08/2020
11/02/2020	Fall	red-tailed hawk	T75	11/08/2020	11/12/2020
11/02/2020	Fall	red-tailed hawk	T84	11/11/2020	11/16/2020
11/02/2020	Fall	red-tailed hawk	T57	11/11/2020	11/16/2020
11/02/2020	Fall	red-tailed hawk	T19	11/20/2020	12/01/2020
11/02/2020	Fall	red-tailed hawk	T46	11/16/2020	12/02/2020
11/02/2020	Fall	red-tailed hawk	T36	12/02/2020	01/31/2021
11/30/2020	Fall	coturnix quail	T72	12/03/2020	12/10/2020
11/30/2020	Fall	coturnix quail	T25	12/03/2020	12/07/2020
11/30/2020	Fall	coturnix quail	T4	12/03/2020	12/07/2020
11/30/2020	Fall	coturnix quail	ALT14	12/07/2020	12/09/2020
11/30/2020	Fall	coturnix quail	T73	12/06/2020	12/10/2020
11/30/2020	Fall	mouse	T33	12/01/2020	12/03/2020
11/30/2020	Fall	mouse	T106	11/30/2020	12/01/2020
11/30/2020	Fall	mouse	T62	11/30/2020	12/02/2020
11/30/2020	Fall	mouse	T31	12/01/2020	12/07/2020
11/30/2020	Fall	mouse	T97	12/06/2020	12/10/2020
11/30/2020	Fall	red-tailed hawk	T66	11/30/2020	12/02/2020
11/30/2020	Fall	red-tailed hawk	T100	12/10/2020	12/13/2020
11/30/2020	Fall	red-tailed hawk	T24	12/17/2020	03/01/2021
11/30/2020	Fall	red-tailed hawk	T83	12/17/2020	03/01/2021
11/30/2020	Fall	red-tailed hawk	T82	12/17/2020	03/01/2021
11/30/2020	Fall	rock pigeon	T17	12/01/2020	12/01/2020
11/30/2020	Fall	rock pigeon	ALT2	12/01/2020	12/01/2020

Appendix D1. All carcasses placed for carcass persistence trials by date, season, species, and turbine at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Date Placed	Season	Species	Turbine	*Before Removal	**After Removal
11/30/2020	Fall	rock pigeon	T50	12/17/2020	12/17/2020
11/30/2020	Fall	rock pigeon	T90	12/13/2020	12/17/2020
11/30/2020	Fall	rock pigeon	T59	12/17/2020	12/17/2020
01/18/2021	Winter	red-tailed hawk	T80	01/19/2021	01/19/2021
01/18/2021	Winter	red-tailed hawk	ALT20	01/19/2021	01/19/2021
01/18/2021	Winter	red-tailed hawk	T54	01/21/2021	01/22/2021
01/18/2021	Winter	red-tailed hawk	T107	01/22/2021	01/23/2021
01/18/2021	Winter	red-tailed hawk	T20	01/22/2021	03/04/2021
01/18/2021	Winter	red-tailed hawk	T3	01/24/2021	03/04/2021
01/18/2021	Winter	red-tailed hawk	T52	03/04/2021	03/19/2021
01/18/2021	Winter	red-tailed hawk	T71	03/04/2021	03/19/2021
01/18/2021	Winter	red-tailed hawk	T6	04/03/2021	04/19/2021
01/18/2021	Winter	red-tailed hawk	T72	04/18/2021	04/18/2021
01/18/2021	Winter	red-tailed hawk	T104	03/18/2021	04/01/2021
01/18/2021	Winter	red-tailed hawk	T84	04/01/2021	04/18/2021
01/18/2021	Winter	red-tailed hawk	T63	04/01/2021	04/18/2021
01/18/2021	Winter	red-tailed hawk	T89	03/18/2021	04/18/2021
01/18/2021	Winter	red-tailed hawk	T92	02/01/2021	03/03/2021
02/01/2021	Winter	coturnix quail	T30	02/02/2021	02/02/2021
02/01/2021	Winter	coturnix quail	T84	02/02/2021	02/02/2021
02/01/2021	Winter	coturnix quail	T85	02/02/2021	02/02/2021
02/01/2021	Winter	coturnix quail	T87	02/02/2021	02/02/2021
02/01/2021	Winter	coturnix quail	T10	02/02/2021	02/05/2021
02/01/2021	Winter	coturnix quail	T73	02/22/2021	03/03/2021
02/01/2021	Winter	coturnix quail	T33	02/05/2021	03/03/2021
02/01/2021	Winter	coturnix quail	T36	02/05/2021	03/03/2021
02/01/2021	Winter	coturnix quail	T34	02/22/2021	03/03/2021
02/01/2021	Winter	coturnix quail	T72	02/03/2021	02/05/2021
02/01/2021	Winter	rock pigeon	T43	02/02/2021	02/02/2021
02/01/2021	Winter	rock pigeon	T107	02/02/2021	02/02/2021
02/01/2021	Winter	rock pigeon	T49	02/02/2021	02/02/2021
02/01/2021	Winter	rock pigeon	T93	02/02/2021	02/02/2021
02/01/2021	Winter	rock pigeon	T51	02/02/2021	02/03/2021
02/01/2021	Winter	rock pigeon	T48	02/03/2021	02/22/2021
02/01/2021	Winter	rock pigeon	T105	02/22/2021	02/22/2021
02/01/2021	Winter	rock pigeon	T55	03/03/2021	03/03/2021
02/01/2021	Winter	rock pigeon	T31	02/05/2021	02/05/2021
02/01/2021	Winter	rock pigeon	T40	02/05/2021	02/22/2021
03/15/2021	Spring	red-tailed hawk	T43	03/21/2021	03/24/2021
03/15/2021	Spring	red-tailed hawk	T28	03/21/2021	03/24/2021
03/15/2021	Spring	red-tailed hawk	T23	04/04/2021	04/13/2021
03/15/2021	Spring	red-tailed hawk	T14	04/04/2021	04/13/2021
03/15/2021	Spring	red-tailed hawk	T38	04/28/2021	04/28/2021
03/15/2021	Spring	red-tailed hawk	T100	04/29/2021	05/06/2021
03/15/2021	Spring	red-tailed hawk	T49	04/28/2021	05/06/2021
03/15/2021	Spring	red-tailed hawk	T40	04/28/2021	05/06/2021
03/15/2021	Spring	red-tailed hawk	T57	05/06/2021	05/06/2021
03/15/2021	Spring	red-tailed hawk	T72	05/06/2021	05/06/2021
03/15/2021	Spring	red-tailed hawk	T47	04/04/2021	04/29/2021
03/15/2021	Spring	rock pigeon	T61	03/19/2021	03/22/2021
03/15/2021	Spring	rock pigeon	T53	03/19/2021	03/22/2021

Appendix D1. All carcasses placed for carcass persistence trials by date, season, species, and turbine at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Date Placed	Season	Species	Turbine	*Before Removal	**After Removal
03/15/2021	Spring	rock pigeon	T64	03/28/2021	04/05/2021
03/15/2021	Spring	rock pigeon	T77	03/28/2021	04/04/2021
03/15/2021	Spring	rock pigeon	T106	03/22/2021	03/25/2021
03/15/2021	Spring	rock pigeon	T83	04/14/2021	04/14/2021
03/15/2021	Spring	rock pigeon	T26	04/04/2021	04/13/2021
03/15/2021	Spring	rock pigeon	T48	04/04/2021	04/13/2021
03/15/2021	Spring	rock pigeon	T26	04/13/2021	04/13/2021
03/15/2021	Spring	rock pigeon	T80	04/13/2021	04/13/2021
03/22/2021	Spring	coturnix quail	T97	03/24/2021	03/25/2021
03/22/2021	Spring	coturnix quail	T15	03/23/2021	03/23/2021
03/22/2021	Spring	coturnix quail	T33	03/24/2021	03/25/2021
03/22/2021	Spring	coturnix quail	ALT9	03/29/2021	04/01/2021
03/22/2021	Spring	coturnix quail	T31	03/28/2021	04/01/2021
03/22/2021	Spring	coturnix quail	ALT20	03/31/2021	04/04/2021
03/22/2021	Spring	coturnix quail	T18	04/01/2021	04/05/2021
03/22/2021	Spring	coturnix quail	T60	03/31/2021	04/11/2021
03/22/2021	Spring	coturnix quail	T99	04/04/2021	04/11/2021
03/22/2021	Spring	coturnix quail	T16	04/12/2021	04/21/2021
03/22/2021	Spring	mouse	T104	03/22/2021	03/22/2021
03/22/2021	Spring	mouse	T93	03/22/2021	03/22/2021
03/22/2021	Spring	mouse	T76	03/22/2021	03/22/2021
03/22/2021	Spring	mouse	T41	03/22/2021	03/22/2021
03/22/2021	Spring	mouse	T11	03/24/2021	03/29/2021
03/22/2021	Spring	mouse	T21	03/26/2021	03/29/2021
03/22/2021	Spring	mouse	T34	03/28/2021	03/31/2021
03/22/2021	Spring	mouse	T46	03/23/2021	03/24/2021
03/22/2021	Spring	mouse	T107	04/04/2021	04/11/2021
03/22/2021	Spring	mouse	T59	04/11/2021	04/20/2021

* Last date checked before removal

** Date checked after removal

*** Trial ended after 90 days

Appendix D2. Carcass persistence models with covariates and distributions for large birds at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021 (n = 81).

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
No Covariates	**No Covariates**	**Weibull**	**245.16**	**0***
Season	No Covariates	loglogistic	246.84	1.68
No Covariates	No Covariates	lognormal	246.88	1.72
Season	No Covariates	lognormal	247.17	2.01
No Covariates	No Covariates	loglogistic	247.43	2.27
Season	No Covariates	Weibull	247.51	2.35
No Covariates	Season	Weibull	250.03	4.87
Season	Season	Weibull	251.26	6.10
Season	Season	loglogistic	252.22	7.06
No Covariates	Season	lognormal	252.40	7.24
Season	Season	lognormal	252.71	7.55
No Covariates	Season	loglogistic	252.79	7.63
Season	-	exponential	267.12	21.96
No Covariates	-	exponential	268.95	23.79

* Selected model

AICc = corrected Akaike Information Criterion

Delta AICc is the change from the minimum AICc

Appendix D3. Carcass persistence models with covariates and distributions for small birds at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021 (n = 57).

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Season	No Covariates	loglogistic	241.22	0
Season	No Covariates	lognormal	242.49	1.27
Season	-	exponential	242.50	1.28
No Covariates	**No Covariates**	**lognormal**	**242.67**	**1.45***
No Covariates	No Covariates	Weibull	242.89	1.67
Season	Season	Weibull	243.16	1.94
No Covariates	-	exponential	243.46	2.24
Season	Season	loglogistic	243.51	2.29
No Covariates	Season	Weibull	243.52	2.30
Season	No Covariates	Weibull	243.77	2.55
No Covariates	No Covariates	loglogistic	244.15	2.93
Season	Season	lognormal	244.76	3.54
No Covariates	Season	lognormal	244.97	3.75
No Covariates	Season	loglogistic	246.75	5.53

* Selected model

AICc = corrected Akaike Information Criterion

Delta AICc is the change from the minimum AICc

Appendix D4. Carcass persistence models with covariates and distributions for bats at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 –April 14, 2021 (n = 48).

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
No Covariates	**No Covariates**	**Weibull**	**199.18**	**0***
No Covariates	No Covariates	lognormal	202.42	3.24
Season	No Covariates	Weibull	202.79	3.61
No Covariates	Season	Weibull	203.78	4.60
No Covariates	No Covariates	loglogistic	204.56	5.38
No Covariates	-	exponential	205.40	6.22
Season	No Covariates	lognormal	205.92	6.74
No Covariates	Season	lognormal	206.82	7.64
Season	No Covariates	loglogistic	207.45	8.27
Season	Season	Weibull	207.59	8.41
Season	-	exponential	208.22	9.04
No Covariates	Season	loglogistic	208.97	9.79
Season	Season	lognormal	210.93	11.75
Season	Season	loglogistic	212.47	13.29

* Selected model

AICc = corrected Akaike Information Criterion

Delta AICc is the change from the minimum AICc

Appendix E. Search Area Adjustment Model Table

Appendix E. Search area adjustment models for bats on road and pad search areas at the Clear Creek Energy Center in Nodaway County, Missouri, from April 15, 2020 – April 14, 2021.

Distribution	AICc	Delta AICc
normal	**96,577.21**	**0***
Gompertz	96,633.16	55.95
Weibull	96,836.80	259.59
Rayleigh	96,895.05	317.84
gamma	97,384.18	806.97

* Selected model

AICc = corrected Akaike Information Criterion

Delta AICc is the change from the minimum AICc

Appendix F. Evidence of Absence Analysis of Special Concern Bat Species

ENVIRONMENTAL & STATISTICAL CONSULTANTS

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TECHNICAL MEMORANDUM

Date: May 4, 2022

To: Tenaska Clear Creek Wind, LLC

From: Ryan McDonald, Andrew Tredennick, and Theodore Owen
Western EcoSystems Technology, Inc.

Subject: Clear Creek Energy Center
Evidence of Absence Analysis of Special Concern Bat Species

Evidence of Absence (EoA) was used to estimate the median cumulative take to-date (M^*) and the mean annual take rate (λ) for northern long-eared bats, tri-colored bats, and little brown bats. Estimates were calculated using the EoA method (Dalthorp et al. 2017), using the Single Class, Multiple Class, and Multiple Year modules of EoA.

The probability of detection (g) was estimated using the bias adjustments for searcher efficiency, carcass persistence, and area searched, as well as the assumed seasonality of risk for northern long-eared bats, tri-colored bats, and little brown bats. Myotis carcass arrival at the Project is assumed to follow the arrival proportions of the Midwest Multi-Species HCP: 7% in spring, 36% in summer, and 57% in fall.

The EoA Single Class module was used to estimate the distribution of detection probability in each search stratum (i.e., each season-by-plot type combination, here road and pad was the only plot type, so the strata were seasons). This resulted in alpha and beta parameters that defined the Beta distribution of detection probability in each stratum. The search area adjustment for road and pad searches was used as the “Spatial coverage (a)” parameter in the Single Class Module.

The Multiple Class module was then used to combine Beta distribution parameters across seasons, relying on the output for each season estimated using the methods described above. Seasonal arrival proportions defined the weights for combining Beta distribution parameters across season. The summer operations were assumed to pose 100% risk to Myotis. The Multiple Years module was used to generate estimates of take rate and cumulative take to date.

Monitoring data were available for three seasons (spring, summer, and fall) in 2020, and limited for one season (spring) in 2021. This analysis did not include data from 2021 because of the limited availability for the 2021 bat season. Therefore, the bat fatality rates presented here represent those estimated for the 2020 bat season.

The site-wide, cumulative detection probability, *g*, for 2020 was 0.019 (95% confidence interval: 0.016 to 0.023). The estimated median cumulative take to-date (*M**) was 112 for tri-colored bats, 11 for little brown bats, and 11 for northern long-eared bats. In 2020, two tricolored bat carcasses were found, zero little brown bat carcasses were found, and zero northern long-eared bat carcasses were found. The estimated take rates for each species are presented in Table 1.

Table 1. Evidence of Absence (EoA) results from bat monitoring conducted between April 15, 2020 and April 14, 2021, at the Clear Creek Energy Center in Nodaway County, Missouri.

Species	Carcasses Found	*M**	Median Annual Rate	Mean Annual Rate	Lower CI	Upper CI
Northern Long-eared Bat	0	11	11.8	26.0	0.0	131.1
Tricolored Bat	2	112	112.6	130.0	21.4	336.9
Little Brown Bat	0	11	11.8	26.0	0.0	131.1

Figure 1. Photo of the tricolored bat found at the Clear Creek Energy Center on August 13, 2020.

Figure 2. Photo of the tricolored bat found at the Clear Creek Energy Center on August 14, 2020.